VOLUME XLVI NUMBER ONE

THE NATIONAL GEOGRAPHIC MAGAZINE

JULY, 1924

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U. S. Army Air Service

Man's Progress in Conquering the Air
With 29 Illustrations
J. R. HILDEBRAND

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ARTICLES and photographs are desired. For material which the Magazine can use, generous remuneration is made. Contributions should be accompanied by an addressed return envelope and postage.

IMMEDIATELY after the terrific eruption of the world's largest crater, Mt. Katmai, in Alaska, a National Geographic Society expedition was sent to make observations of this remarkable phenomenon. Four expeditions have followed and the extraordinary scientific data resultant given to the world. In this vicinity an eighth wonder of the world was discovered and explored—"The Valley of Ten Thousand Smokes," a vast area of steaming, spouting fissures. As a result of The Society's discoveries this area has been created a National Monument by proclamation of the President of the United States.

AT an expense of over $50,000 The Society sent a notable series of expeditions into Peru to investigate the traces of the Inca race. Their discoveries form a large share of our knowledge of a civilization waning when Pizarro first set foot in Peru.

THE Society also had the honor of subscribing a substantial sum to the expedition of Admiral Peary, who discovered the North Pole.

NOT long ago The Society granted $25,000, and in addition $75,000 was given by individual members to the Government when the congressional appropriation for the purchase was insufficient, and the finest of the giant sequoia trees of California were thereby saved for the American people.

THE Society is conducting extensive explorations and excavations in northwestern New Mexico, which was one of the most densely populated areas in North America before Columbus came, a region where prehistoric peoples lived in vast communal dwellings and whose customs, ceremonies, and name have been engulfed in an oblivion.

THE Society also is maintaining expeditions in the unknown area adjacent to the San Juan River in southeastern Utah, and in Yunnan, Kweichow, and Kansu, China—all regions virgin to scientific study.

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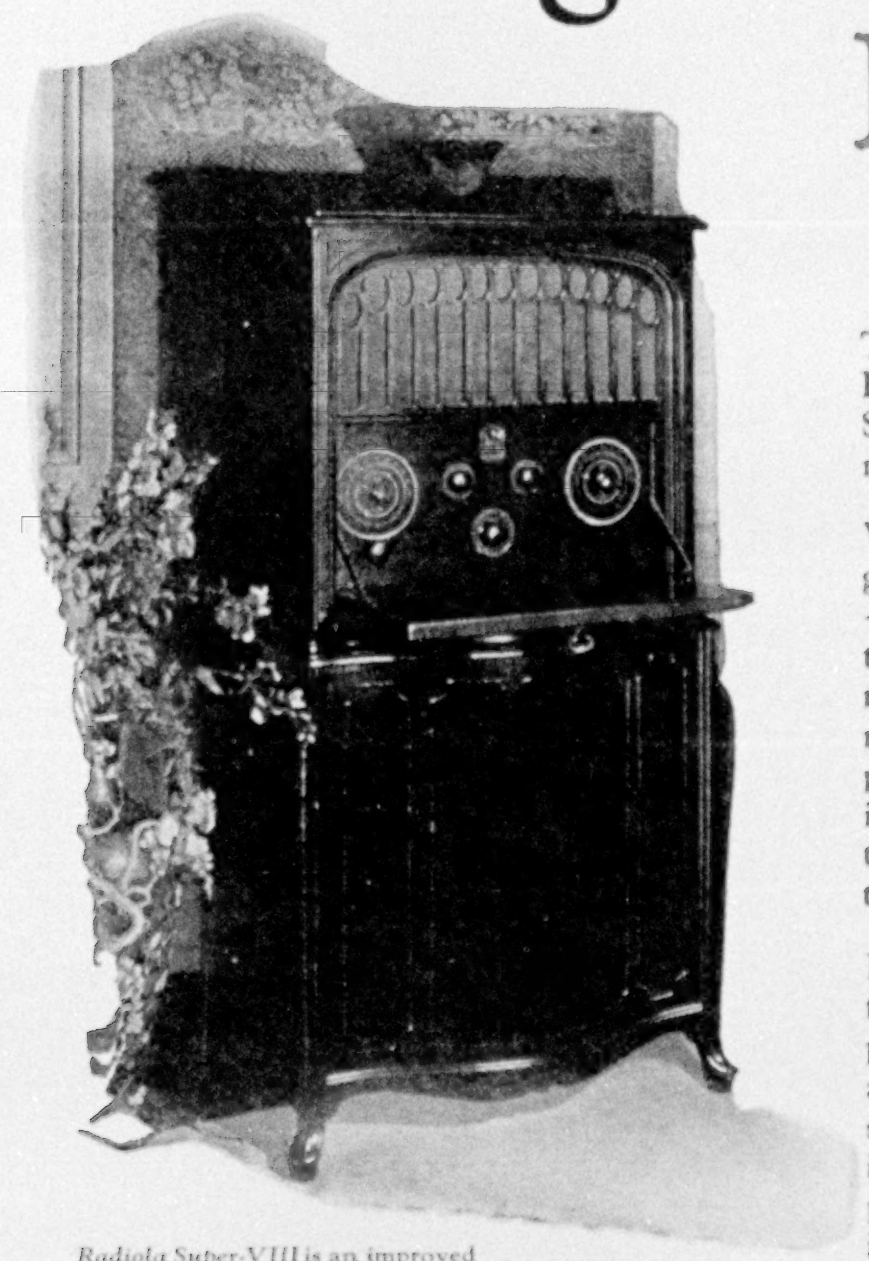

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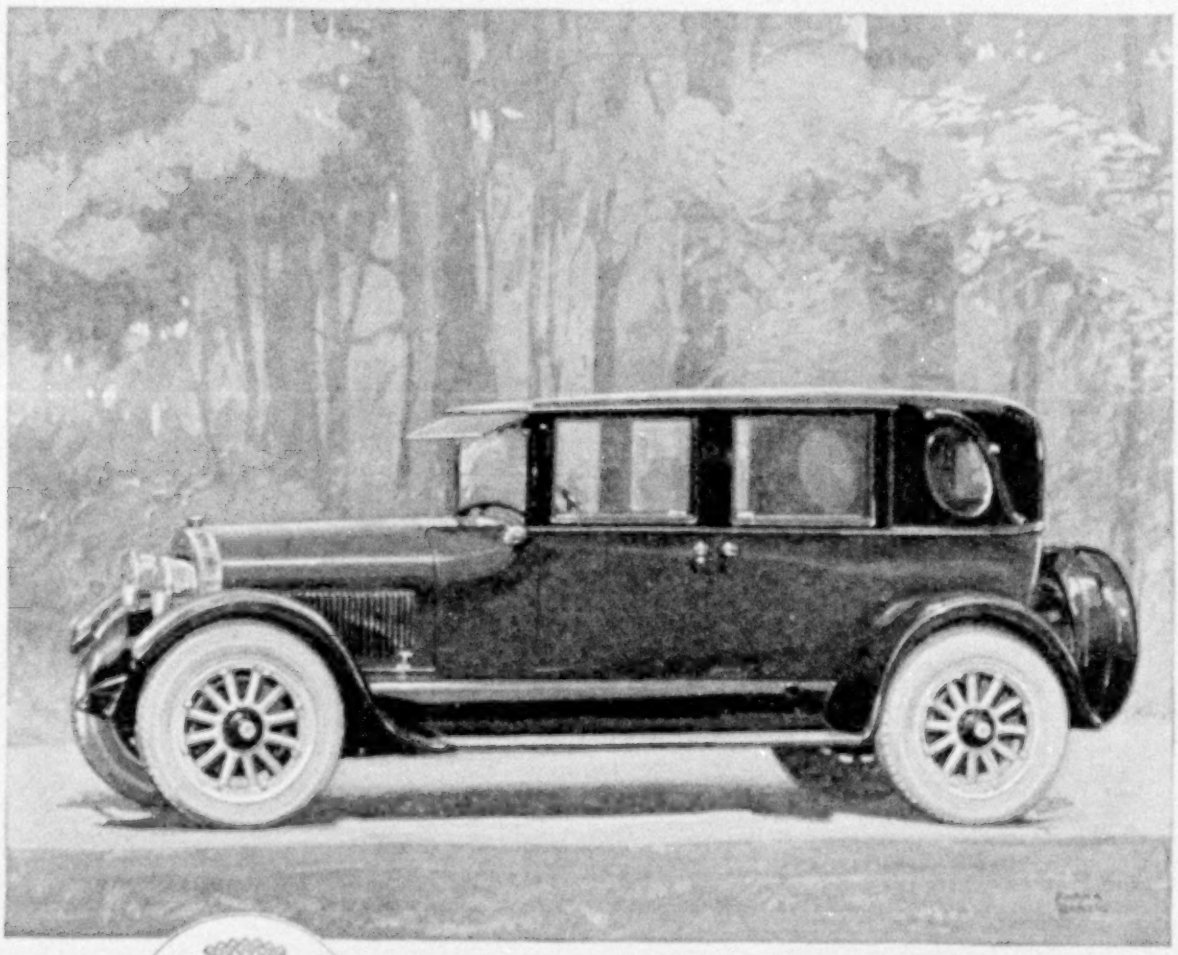

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V-63

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¶ Three Cruises to the West Indies—January & February, 1925. S.S. "Reliance" (20,200 tons—Harriman Lines). January 16—Bermuda, Porto Rico, Jamaica, Havana, 16 days; rates $175 and upward. January 31 and February 28—Havana, Jamaica, Panama, Venezuela, Trinidad, Martinique, the Virgin Islands, Porto Rico, Bermuda. 26 days; rates $350 and upward.

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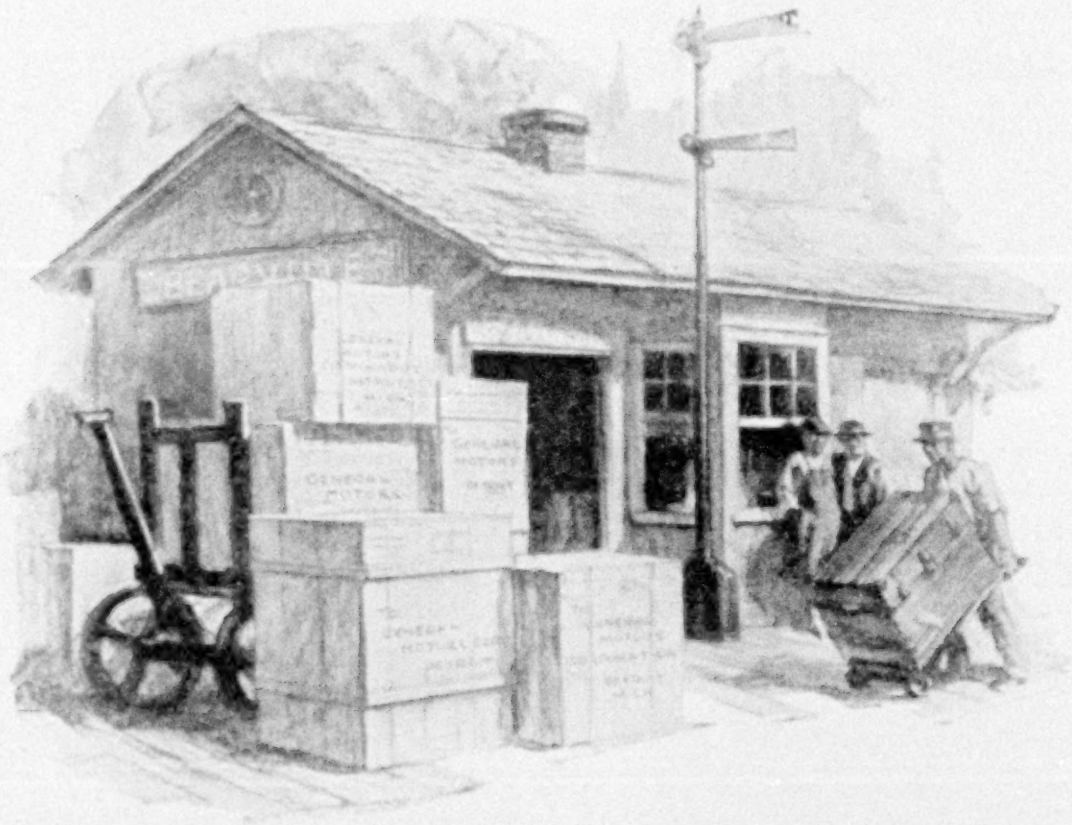

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(27,200 tons)

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in cooperation with

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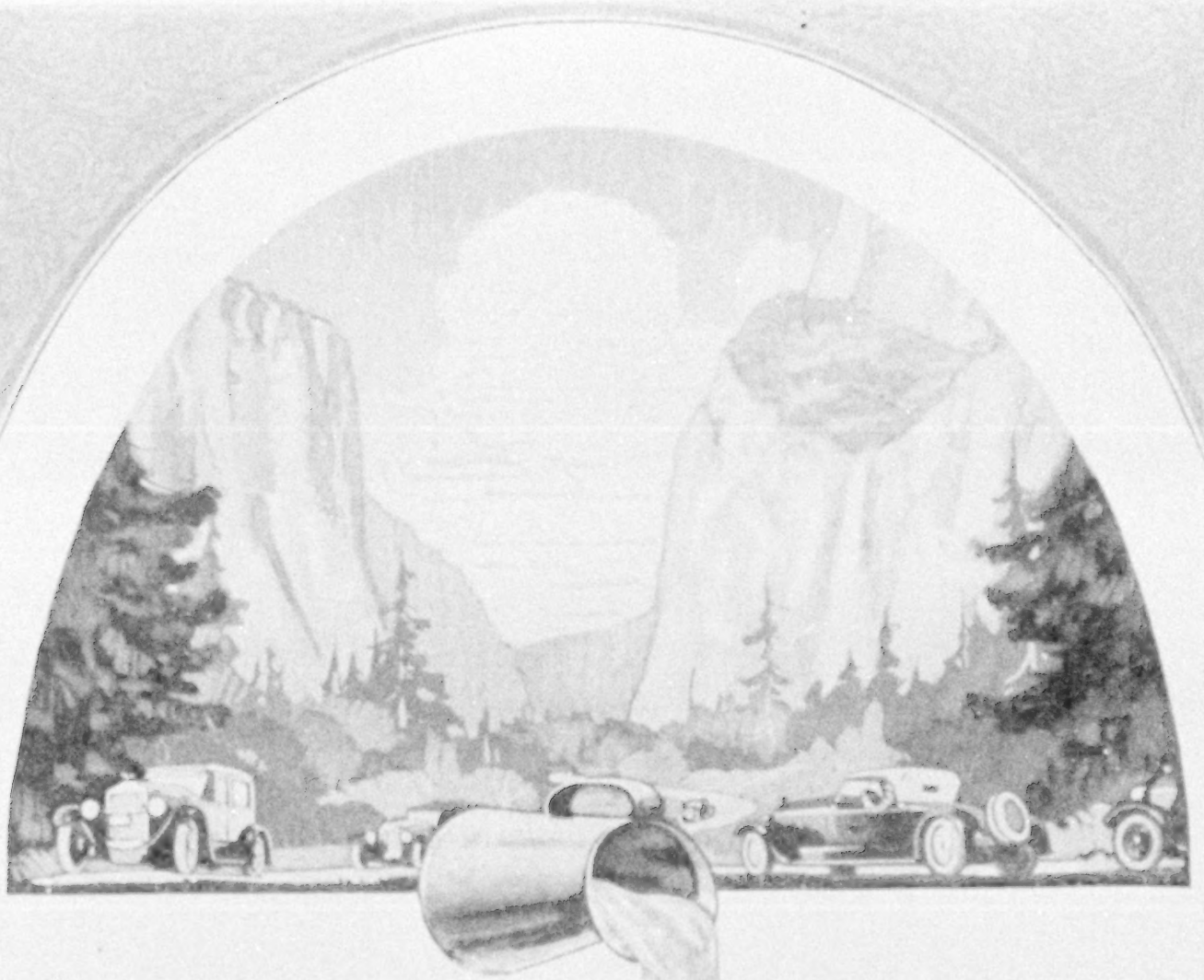

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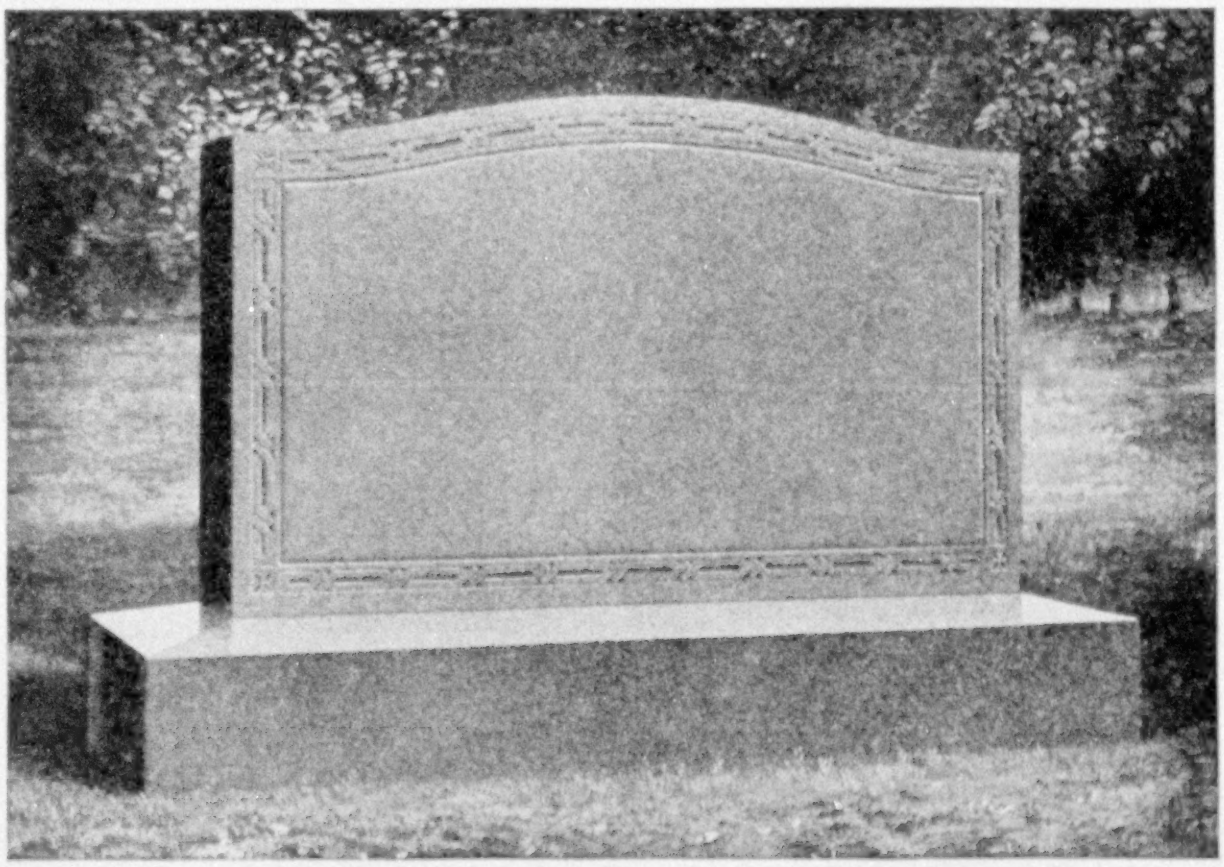

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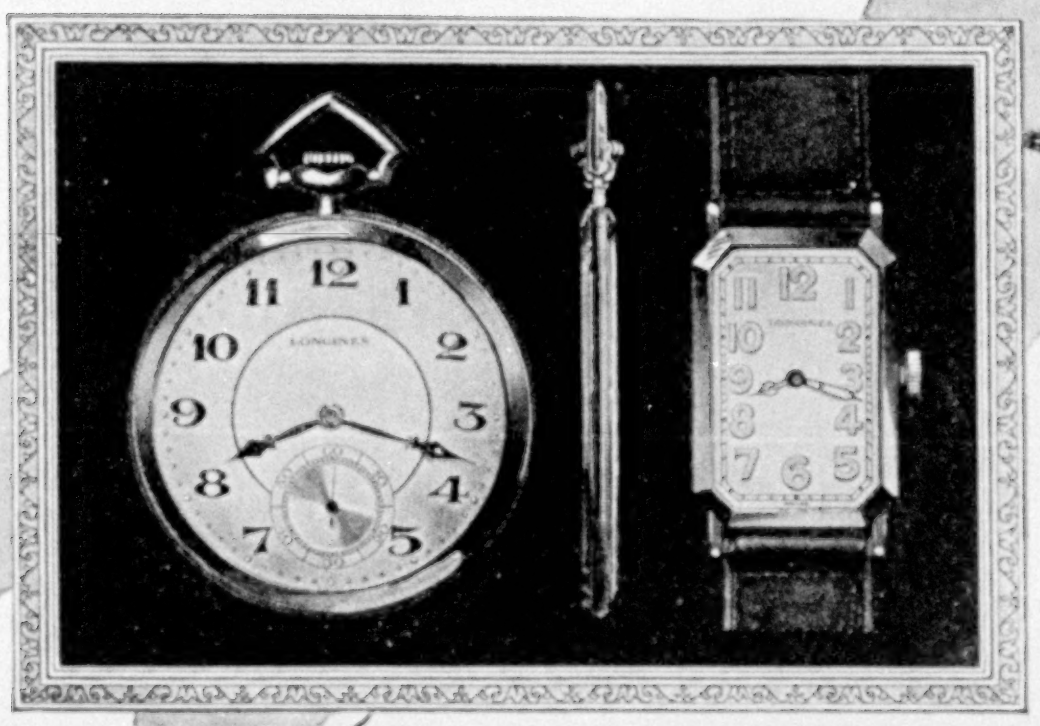

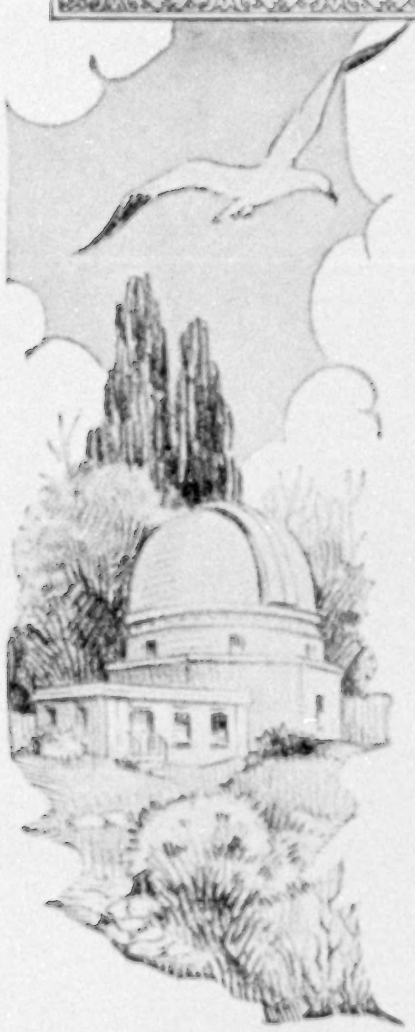

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Under the severe conditions imposed for such tests, the Longines Watch has received more official government awards than any other watch. Again and again it has carried off the coveted honors,—earned through its superior accuracy.

For more than fifty years, better jewelers have recommended it. Prices range from $35 upward. *Booklet upon request.*

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The Longines WATCH

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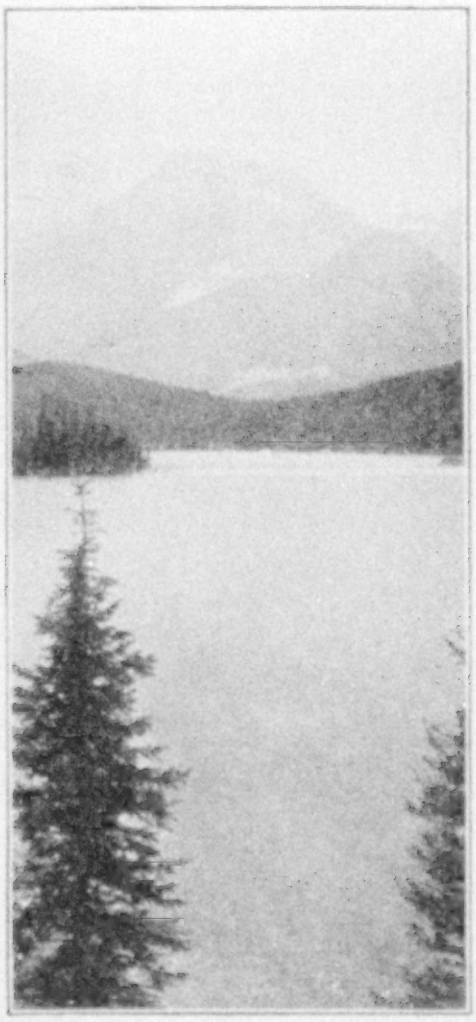

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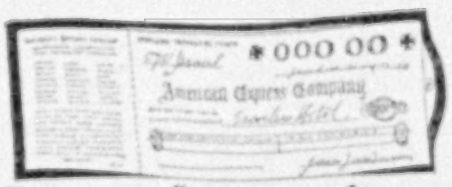
GENERAL ELECTRIC

"Chequing" a fine art in traveling

You check your coat

You check your bag



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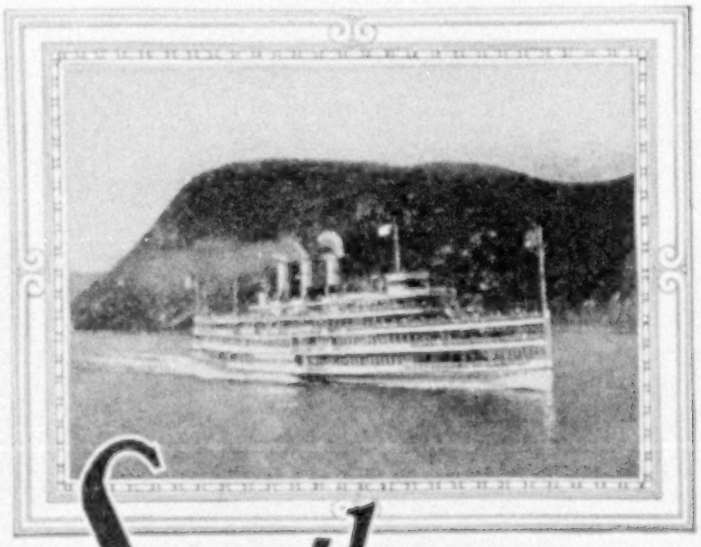

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A delightful water route
between
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For 150 miles an endless panorama of Nature's most superb handiwork viewed in cool comfort from the spacious decks of the magnificent Day Line flyers! It is an experience you cannot afford to miss.

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Opportunities of doing so under the most favorable conditions imaginable are offered by our *Cruises Supreme 1925.*

The MEDITERRANEAN

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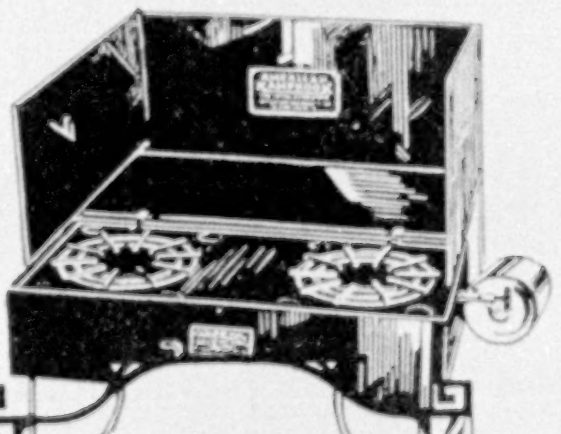

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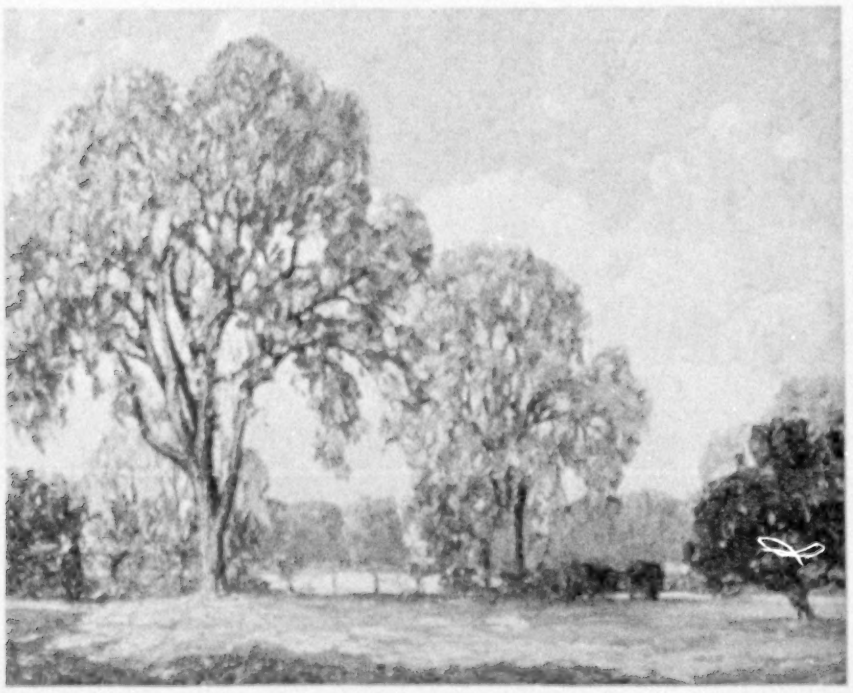

Reproduction from a painting of Harbel Manor, the estate of H. S. Firestone, Akron, Ohio, by Frank Swift Chase

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Danger Symptoms in your trees

Among prominent persons and institutions served by Davey Tree Surgeons are the following:

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DE PAUW UNIVERSITY
POTTER PALMER
COL. H. H. ROGERS

Are the leaves of any one of your trees turning brown prematurely? In many cases this is caused by a lack of water or possibly by a lack of food. It might indicate a gas leak or some special disease.

Are any of the leaves yellowish? The leaves of most trees have a rich dark green color, and a yellowish appearance often indicates a lack of water, or a lack of food in the soil (probably nitrogen), or both.

Are any of the leaves undersized? This generally indicates a lack of food elements; namely, nitrogen, phosphorous and potassium. A tree requires food just the same as any other living thing.

Is the foliage of any tree thin or sparse? This usually indicates a lack of both water and food. It might mean an attack by a specific insect or disease.

Is any tree dying back at the top? This might signify that the roots had been smothered, or cut too severely, or drowned, or that the water had been drained away. It might indicate a lack of food elements, or a serious insect attack.

Is any tree full of dead branches? If so, the tree may be too dense, or it may be suffering from a specific disease or insect enemy. Dead branches are a menace to the health of a tree.

Is the bark splitting or falling off? This might be caused by frost injury, or sun scald, or gas poisoning, or some mechanical injury.

Does any tree have a V-shaped crotch? Is this crotch starting to split apart? If not, it is only a question of time until it will. Splitting crotches are often indicated by a large bulge on either side, or by discolored water oozing out.

Are there any decaying cavities? Open cavities are easily observed, but many times decay is hidden. Decay results from active fungous diseases; once started, it never stops until arrested by human skill. The principles of treatment are somewhat similar to dentistry. Hidden decay may be indicated by a swollen place on the trunk, or by a sunken bark area or by a dried bark area, or by a bark discoloration, or by small holes. Sometimes it is indicated by wood dust on the bark or on the ground.

A tree with any of these symptoms needs a real Tree Surgeon. It is on the way to premature death. It might be too far gone to save, but if it is possible to save it Davey Tree Surgeons can do it. Write or wire nearest office.

JOHN DAVEY
Father of Tree Surgery

Reg. U. S. Pat. Off.

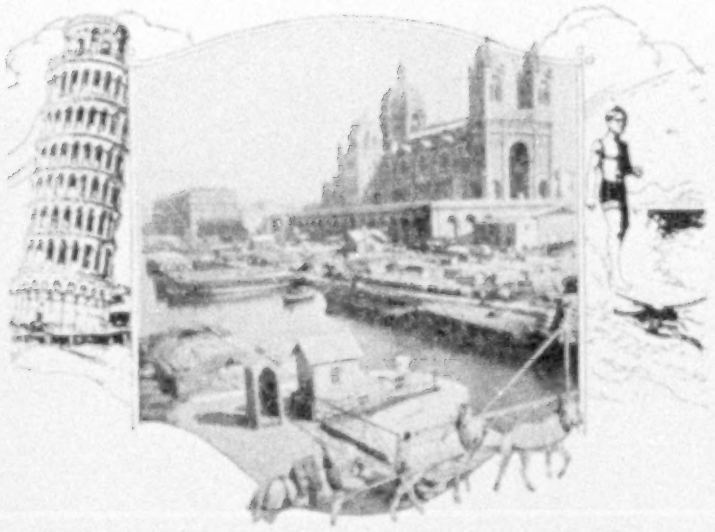
THE DAVEY TREE EXPERT CO., Inc., 208 City Bank Bldg., Kent, Ohio

Branch offices with telephone connections: New York, Astor Trust Bldg., Fifth Ave. and 42nd St.; Albany, Volkert Bldg.; Boston, Massachusetts Trust Bldg.; Philadelphia, Land Title Bldg.; Baltimore, American Bldg.; Pittsburgh, 331 Fourth Ave.; Buffalo, 110 Franklin St.; Cleveland, Hippodrome Bldg.; Detroit, General Motors Bldg.; Cincinnati, Mercantile Library Bldg.; Louisville, Todd Bldg.; Indianapolis, Lombard Bldg.; Chicago, Westminster Bldg.; St. Louis, Arcade Bldg.; Kansas City, Scarritt Bldg.; San Francisco, Hobart Bldg.; Montreal, 252 Langauchetiers, West.

DAVEY TREE SURGEONS

Every real Davey Tree Surgeon is in the employ of The Davey Tree Expert Co., Inc., and the public is cautioned against those falsely representing themselves. An agreement made with the Davey Company and not with an individual is certain evidence of genuineness. Protect yourself from impostors. If anyone solicits the care of your trees who is not directly in our employ, and claims to be a Davey man, write headquarters for his record. Save yourself from loss and your trees from harm.

XUM



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This service also provides Round the World trips in 110 days, with sufficient time at each of the 21 ports for short trips to the interior.

While in port (except for the week at New York) the ship is your hotel without additional expense.

Tickets may be purchased between any ports of call as well as Round the World.

See the world's most interesting sights. From New York you make Havana, the Panama Canal and the Pacific Coast. Continue to Hawaii, Kobe, Shanghai and Hong Kong.

Manila and the British Straits Settlements promise much for the visit, whether long or short. The Suez Canal brings you to Alexandria, then Naples, Genoa and Marseilles, our port of departure for Boston and New York.

Here is the service which enables you to see the things that most interest you with an unusual degree of ease and comfort.

Yet the entire Round the World trip costs about the same as your ordinary home expenses.

Send the coupon to us for additional information. Or call the local Dollar Steamship Line office, or any local ticket or tourist agent.

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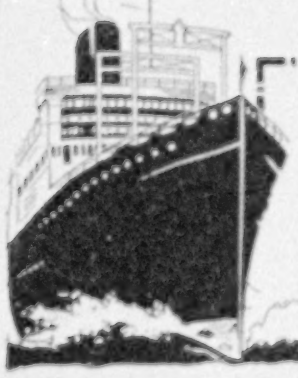

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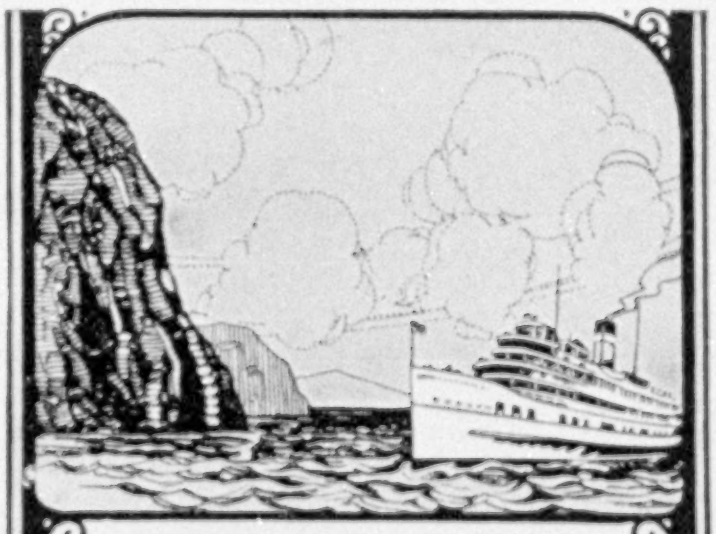

A Trip to Yesterday

A voyage to Montreal, old Quebec, and on through the stupendous gorge of the Saguenay, is an experience unforgetable. From the deck of modern, luxurious steamships of the Canada Steamship Lines, this land of romance and adventure is yours to rediscover.

You can begin your journey at Niagara Falls, Toronto, Rochester, Alexandria Bay, Clayton, Montreal, or Quebec, and return the same way.

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A Thousand Miles of Travel
A Thousand Thrills of Pleasure

CANADA STEAMSHIP LINES

"... needs a friend"

THE famous cartoons "When a Feller Needs a Friend" are familiar to millions of newspaper readers. You will find *this* "feller" wherever there are children of the poor cooped up in squalid quarters.

"GEE! I WISH SOMEBODY'D INVITE ME TO THE COUNTRY AGIN THIS YEAR"
"I WISH I KNEW A BOY WHO WOULD LIKE TO SPEND A WEEK OR TWO UP HERE"
?
WHAT ARE WE GOING TO DO ABOUT IT?
© 1924, M. L. I. CO.

The Fresh Air Funds organized by newspapers and other kindly folk are doing a splendid work in getting children out of the city and into the country. They need your help.

Find out what is being done in your community to give these poor, pinched, nature-starved children the happiest time of their lives. If a Fresh Air Fund has been started give it your heartiest support. But if nothing of the kind is under way won't you ask your favorite newspaper to help start a Fresh Air Campaign? They know all about the work that other big newspapers are doing. Don't wait. There is not a precious minute to lose—the Summer will slip away so fast.

If you live in the country will you share your home with some poor child this Summer—even for two weeks? Your own newspaper undoubtedly knows of boys and girls who need just the help that you can give. Poor youngsters—it will be the first time that many of them have seen a green field or brook or real woods. Fire escapes, burning hot side-walks, brick walls—these are the wretched substitutes for trees and flowers that they have known.

The gratitude of the boys and girls who are taken into private homes is pathetic. It is usually their first glimpse of a real home.

If you have children of your own think what it would mean to see them drooping and withering in the stifling heat of dark airless rooms all Summer, playing tag with death in truck-jammed streets.

In memory of your own happy childhood—or perhaps in regret for the fun that you've missed—will you help? If you are in the city, send some needy children to the country. If you are in the country, take them away from the city. It is a splendid thing to do.

One great metropolitan newspaper claims that it can send a child to the country for two weeks for only $7. The same newspaper figures that last year it gave the children of its city more than 500 years of happiness! 14,000 children were given fresh air vacations—two weeks each; 6,000 were placed in the camps maintained by this newspaper and 8,000 were sent to private homes. But there were 35,000 applications for these 14,000 places—less than half were taken care of.

The boys and girls were given a critical physical examination before they were sent off. Careful record was kept of a certain group of these children and it was found that the average gain in weight at the end of a two weeks' stay in the country was nearly five pounds for each child.

No social service is more important than this of building healthy boys and girls. A vacation in the right environment may mean a permanent change in the life of a child.

This is the time of the year when every boy and girl "needs a friend". How many youngsters will you make happy?

HALEY FISKE, *President.*

Published by

METROPOLITAN LIFE INSURANCE COMPANY~NEW YORK

Biggest in the World, More Assets, More Policyholders, More Insurance in force, More new Insurance each year

Victrola production larger than ever

In order to insure the greatest possible production from the Victor factories—the largest in the world devoted to musical products—manufacturing schedules for the entire year have been approved earlier than usual. They call for 48% more Victrola instruments than we made in 1923.

Present and future Victrola owners can share our satisfaction in knowing that Victor quality has made such plans possible.

Twenty-one Victrola styles from $25 up.

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PONSELLE
Victor Artist

The voice of Ponselle is a story. She sings; she more than sings: she transforms situations and events into glorious melody. This is the more striking in her Victor Records; in playing such records as those given below we feel her presence walking across the stage of our imaginations on wings of sound:

		Double-faced
Aïda—Ritorna vincitor Aïda—O patria mia	6437	$2.00
Ernani—Ernani involami Forza del Destino—Pace, pace mio Dio	6440	2.00
Cradle Song (Brahms) Lullaby (Rossetti-Scott)	1002	1.50

Victrola No. 50 (Portable)
$50
Mahogany or oak

© Mishkin

RACHMANINOFF
Victor Artist

Rachmaninoff knows music; knows how to compose it, how to play it, and how it should be reproduced. It is significant that in the light of previous experience, he chose the Victor to reproduce his art. Of the twenty-nine records listed, none perhaps give greater insight into the personality of the artist nor of his profound genius:

		Double-faced
Prelude in G Major (Rachmaninoff) Prelude in G Minor (Rachmaninoff)	6261	$2.00
Prelude in C Sharp Minor (Rachmaninoff)	814	1.50
Spinning Song Polka de W. R. Troika en traineaux	6260	2.00

Victrola No. 210
$110
Mahogany, oak or walnut

SCHUMANN-HEINK
Victor Artist

To know the work of an artist and to know it well is to appreciate doubly the Victor Records made by that artist. Mme. Schumann-Heink has been heard by so many American audiences that unless her Victor Records were indeed her other self the discrepancy would be noted, not by the few but by the many. The fact is that intonation, interpretation, phrasing, these things on Victor Records are Schumann-Heink herself as the following records serve to show:

		Double-faced
Adeste Fidelis Nearer My God to Thee	829	$1.50
In the Sweet Bye and Bye Sometime We'll Understand	832	1.50
Old Folks at Home The Rosary	6277	2.00

Victrola No. 240
$125
Mahogany, oak or walnut

"HIS MASTER'S VOICE"

There is but one Victrola and that is made by the Victor Company—look for these Victor trade marks

TRADE MARK
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Victor Talking Machine Company, Camden, N. J.

VOL. XLVI, No. 1 WASHINGTON JULY, 1924

THE NATIONAL GEOGRAPHIC MAGAZINE

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THE NON-STOP FLIGHT ACROSS AMERICA

By Lieutenant John A. Macready,
U. S. Army Air Service

With Illustrations from Photographs by Lieutenant A. W. Stevens

"YESTERDAY, when we were in New York," said Kelly at San Diego, as he poured out a cup of hot coffee from a bottle filled the previous day on Long Island by the lovely wife of the commanding officer of Mitchel Field, and until this time unopened, "we did not definitely know that we would hop across the continent until about 11 o'clock, and had plenty of time for lunch before leaving. We're just about in time for lunch now, aren't we?"

We were told that it was a bit early for lunch in San Diego, but Major H. H. Arnold, the commanding officer of Rockwell Field, immediately invited us to dine at his home when the midday meal was ready, and we accepted with alacrity, as driving a big heavy plane like the *T-2* for 2,700 miles, across the continent without stopping, certainly gives one an appetite.

We left Long Island, New York, at 12:36 p. m., May 2, 1923, and arrived at Rockwell Field, San Diego, at 11:26 the next morning—from an island in the Atlantic Ocean to an island in the Pacific—lunch in New York one day and lunch in San Diego the next day.

PROBLEMS SOLVED BEFORE FLIGHT BEGINS

The transcontinental non-stop flight was originally Lieutenant Oakley G. Kelly's idea and he deserves the credit for most of the preliminary work.

The majority of people probably think that all we had to do to make the flight was to climb into the plane, start across, and trust to luck. But transcontinental non-stop flights and endurance records are primarily made on the ground. Success or failure depends largely on the work and preparation that is done before the plane takes the air.

The plane to be used must first be decided upon and chosen; then remodeled and changed to fit the requirements.

The performance of the airplane must be accurately determined for all conditions.

Wind and weather must be studied and the nature of the flight arranged to benefit by these agencies.

The geography, topography, and elevations of the United States must be ascertained and a route adapted to pass over the most favorable territory.

The course must be decided upon, laid out, and many maps made for use in flight.

Gasolines, oils, and maintenance accessories must be tested and tried out and the most satisfactory ones for the project adopted.

The problem of flying for thirteen or fourteen hours in darkness required study and much thought, as it was entirely new. Great application would be necessary in order to keep our bearings throughout the long night.

After many tests and experiments the Army Air Service Transport *T-2* was selected as the most logical airplane. It

Official Photograph, U. S. Army Air Service

THE GASOLINE AND OIL USED IN THE FIRST NON-STOP TRANSCONTINENTAL FLIGHT, NEW YORK TO SAN DIEGO

On the final take-off of the trip on which Lieutenant Macready (on left) and Lieutenant Kelly (on right) made their remarkable flight they had 10,850 pounds of load, including 737 gallons of gasoline and 40 gallons of oil.

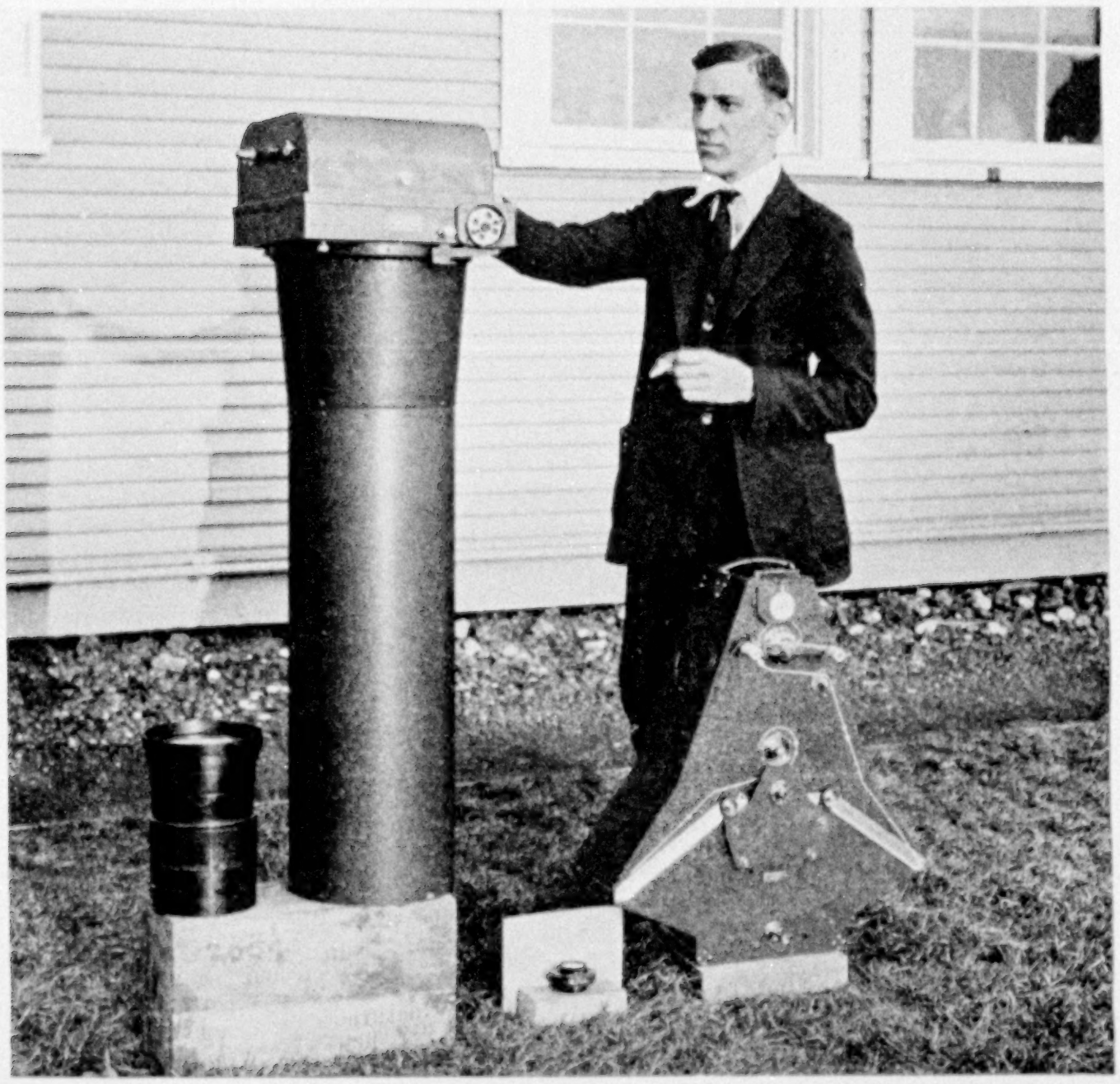
was then necessary to ascertain if the plane could be remodeled to fit the required conditions, and after remodeling to find out what the plane was capable of doing, how much gasoline and oil the engine would consume, how much total load it would lift, how high it would climb with certain loads, how long it would take to climb to various altitudes, and how fast it would travel.

ONLY 150 POUNDS TO SPARE WHEN PLANE STARTS WITH 10,850-POUND LOAD

All this required careful figuring. There was a tremendous amount of engineering data and study that was necessary and weeks were spent in work and consideration of all aspects of the problem.

Lieutenant Ernest W. Dichman is a slow-moving individual, but his engineering ability is above reproach, and we later found in actual practice that the volumes of engineering figures and data which he furnished checked to the smallest details in actual flight, and that whenever there was a difference it was on the side of conservatism and in our favor.

For example, we knew that theoretically the absolute ceiling of the *T-2* with 11,000 pounds total load was the ground. In other words, the plane would neither lift off the ground in flight nor stay on



Official Photograph, U. S. Army Air Service

THE HIGH-ALTITUDE CAMERA WITH WHICH MANY OF THE PICTURES ILLUSTRATING THIS NUMBER OF "THE GEOGRAPHIC" WERE MADE

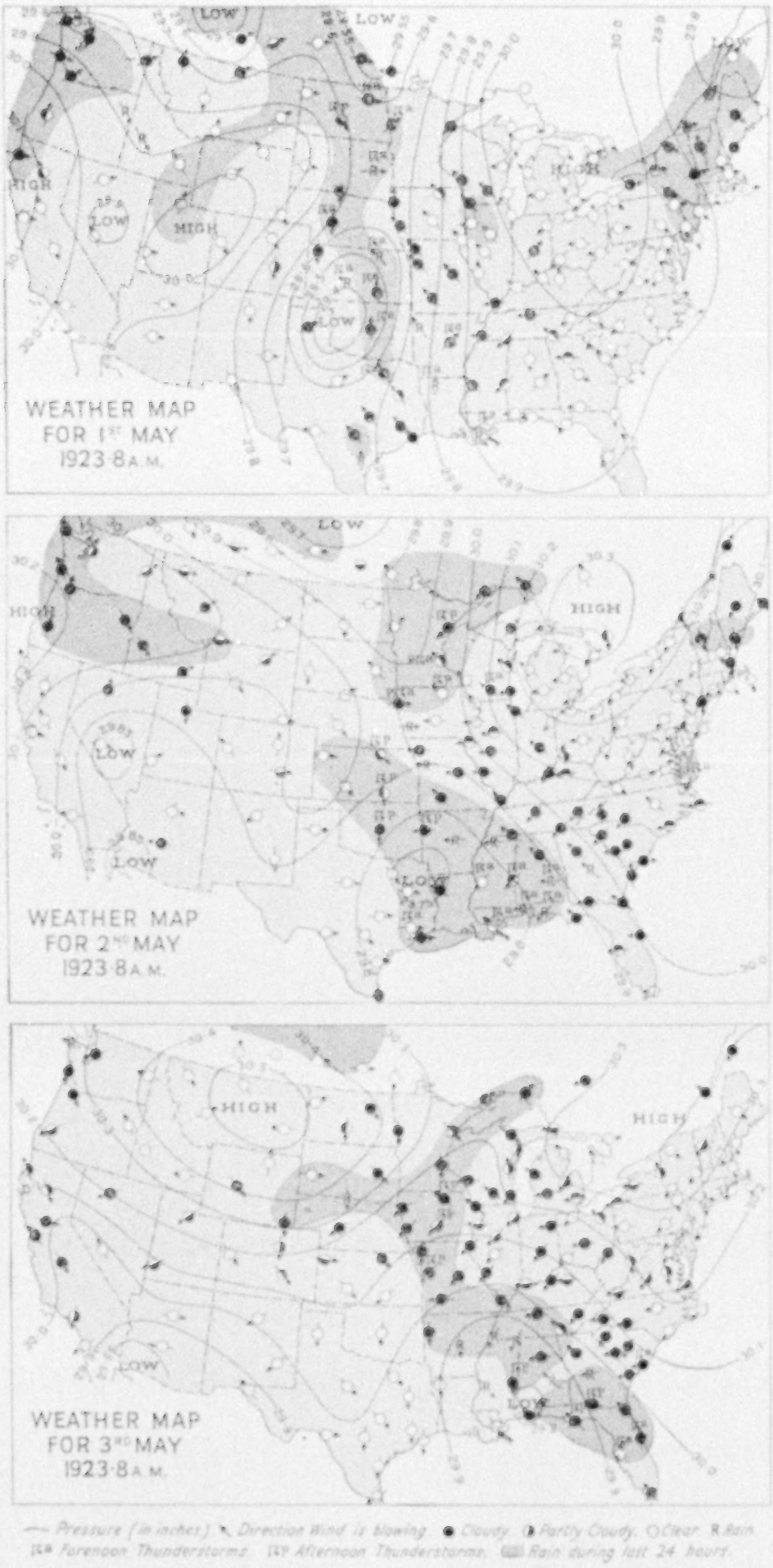
Beside the camera is its big lens, having a focal length of 36 inches. The smaller triangular camera has three lenses, which supplement each other, so that a broader area can be included in a single picture. The six-miles-high photograph was taken with another type of camera (see pages 84 and 86).

the ground with this load at sea-level, as the total lift of the wings exactly balanced the force of gravity. We had 10,850 pounds of load for the final take-off. One can easily see that the figures must be very reliable.

A large proportion of the public does not realize that there is a limit to the height that each plane will go. This limit depends on many factors, but the principal ones are the weight or load carried and the power of the engine. Engines lose power as they ascend into rarefied air. A 420-H. P. Liberty engine develops about 170-H. P. at 20,000 feet.

Many persons do not know that wind affects the speed of the airplane, measured across the surface of the ground. An airplane's speed is relative to the air. That of the wind is added if the plane goes with it, and subtracted if flying against it.

If the air speed of the *T-2* was 100 miles per hour and a twenty-miles-an-hour wind blew toward and against the front of the plane, the speed across the



Drawn by Chas. E. Riddiford

WEATHER MAPS SHOWING THE CONDITIONS UNDER WHICH THE TRANSCONTINENTAL, NON-STOP FLIGHT WAS MADE (SEE TEXT, PAGE 53)

ground would be 80 miles per hour. If a twenty-mile wind blew the plane from the rear, its speed would be 120 miles per hour.

In a transcontinental non-stop flight the consumption and performance of the engine and airplane, elevations that the plane must pass over, and the direction and strength of the prevailing wind are factors which are closely connected in their effects. In other words, the pilot must know how much weight or load the plane will have at a certain time, how high it will climb with that load, and where it will be.

As each gallon of gasoline is consumed, the weight is lessened and the plane can go a little higher. The route of travel must be gauged to have no elevations in the path of flight which are higher than it is possible for the plane to climb. If the airplane will only go 5,000 feet with a certain load, it would be useless to attempt to pass over mountains or elevations of 6,000 or 7,000 feet.

THE IDEAL CONDITIONS FOR A LONG FLIGHT

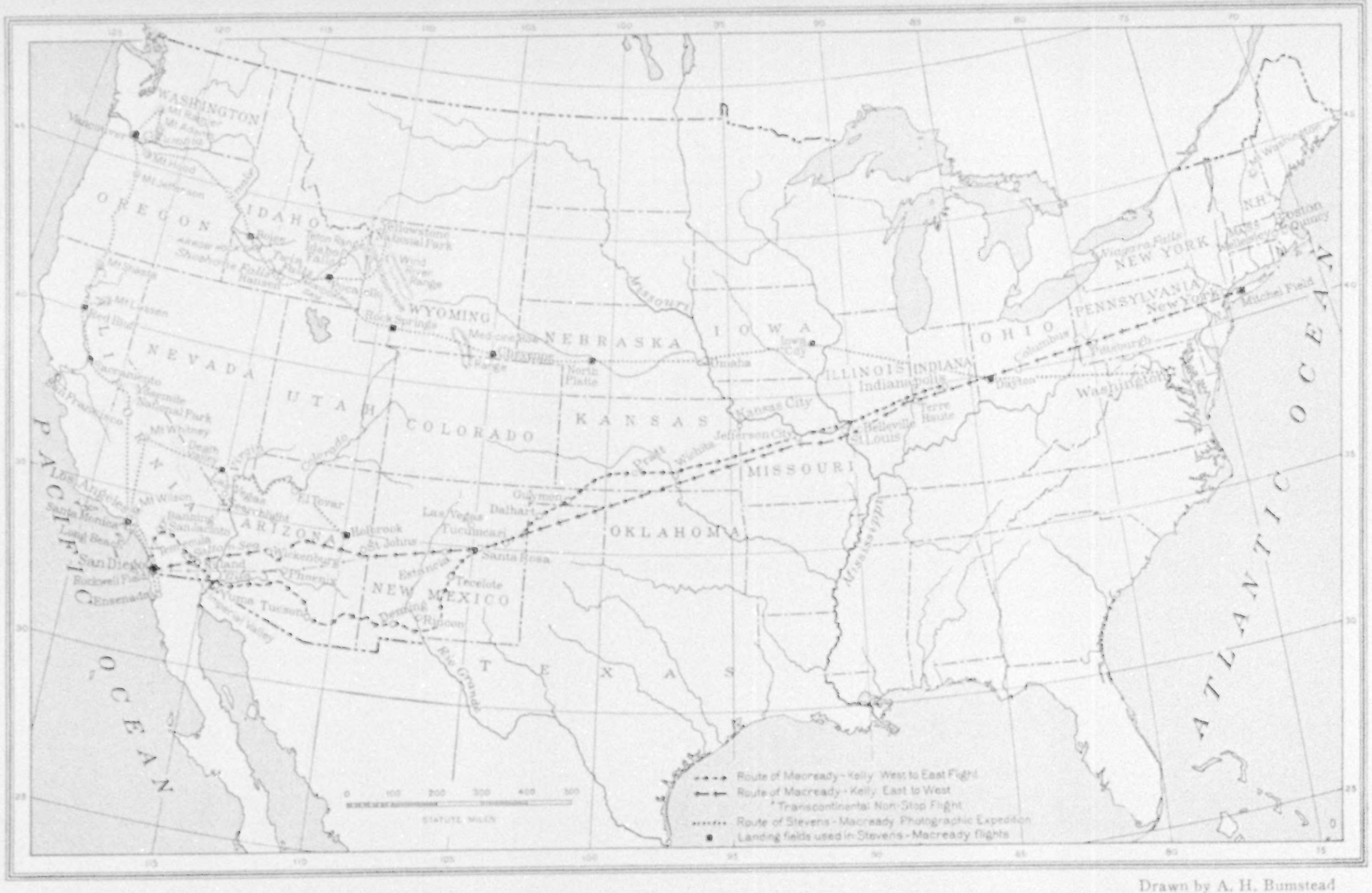
The ideal conditions for a flight of this nature are a clear sky, moonlight, and helping winds, with low elevations to cross, especially at night.

The possible natural obstacles were principally the long flight at night over strange mountainous country, the wind and weather, and

Official Photograph, U. S. Army Air Service

LIBERTY BIDS THE FLYER GODSPEED

By night this statue, with flood lights around the base and the great torch gleaming above, is a beautiful beacon for the aviator. Ahead of the flyer is the glow of Manhattan Island, to one side are the rows of lights of Jersey City as far as the eye can see, and on the right are the lights of Brooklyn and Long Island (see text, page 85).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Alexandria
Richmond
Petersburg
Norfolk
Newport News
Hampton
Roanoke
Lynchburg
Charlottesville
Fredericksburg
Manassas
Harpers Ferry
Martinsburg
Cumberland
Uniontown
Connellsville
Pittsburgh
Wheeling
Parkersburg
Huntington
Ashland
Ironton
Portsmouth
Chillicothe
Zanesville
Cambridge
Steubenville
Columbus
Springfield
Dayton
Hamilton
Cincinnati
Lexington
Frankfort
Louisville
Owensboro
Evansville
Mt Vernon
Shawneetown
Cairo
Paducah
Hopkinsville
Bowling Green
Nashville
Chattanooga
Knoxville
Bristol
Johnson City
Asheville
Greenville
Spartanburg
Columbia
Charleston
Savannah
Jacksonville
Tallahassee
Pensacola
Mobile
Montgomery
Birmingham
Gadsden
Anniston
Atlanta
Macon
Augusta
Athens
Gainesville
Tampa
St Petersburg
Orlando
Miami
Key West
Havana
Nassau
Bermuda
Cape Hatteras
Cape Lookout
Cape Fear
Wilmington
Florence

the elevations. Their effects were very closely interwoven. Our own physical capabilities were also considered. No person had ever flown continuously for more than 26½ hours, and many people told us that the flight was beyond human endurance.

Bad weather in the daytime would not bother. We would have started in a rainstorm, had the winds been right and the conditions at night favorable.

MOUNTAIN STORMS DREADED

We dreaded storm conditions over the mountains at night. No one had ever flown across country under these circumstances and we did not know whether or not a plane would be beaten to the ground.

We would take the best that we could get, but we hoped for a full moon, clear sky, and strong tail wind. A start would have been made in the dark of the moon, had all other conditions been ideal.

Sufficient moonlight exists on only few nights during the month, a tail wind over a long distance is unusual, and a clear sky, especially in the eastern part of the United States, is less than a fifty-fifty chance. We could only hope for conditions as near these as possible. The ideal conditions never come in flying over a long stretch. If we had waited for them along the entire route, we would have been waiting yet.

The wind and weather situation was quite a complicated problem. We received splendid assistance from the Weather Bureau, although at first I imagine that those in charge did not appreciate the seriousness of our undertaking.

Weather for farmers and crops is not weather for transcontinental non-stop flights, and at first there was some slight confusion due to the fact that the Weather Bureau did not understand our exact needs. Later on, when our problem was better appreciated, the coöperation was excellent. All that we had to do was to put in our order for weather when we were ready and the Bureau did its best to produce it!

We made three attempts to accomplish a transcontinental non-stop flight. The first two were from west to east and the final one from east to west. The reason for the original decision to start from the west and the subsequent change after trial to the east needs explanation.

Without consideration of the wind and weather, New York or the east coast is the logical point from which to start across the continent. The elevations around New York and near the Atlantic coast are low, and practically a direct route can be flown the entire distance from Long Island to San Diego, as the high elevations do not occur until southern Colorado, western New Mexico, and Arizona are reached. Here the altitudes are very great, but the airplane is lighter in weight and can consequently fly higher. With a full load of gasoline, it is impossible to fly high.

The opposite condition exists if a start is made from the Pacific side, as high mountains fringe the coast-line and the passes are few and far between. It would be necessary to go north from Rockwell Field for a considerable distance before finding a pass among the mountains low enough to fly through. After accomplishing this, the plane would have to follow in a winding fashion the low topography of the ground, and in so doing go a long distance south of a straight course across the continent. The west-to-east route is, therefore, less desirable and adds about 300 miles to the flight.

WEATHER MAPS CAREFULLY STUDIED

When the transcontinental flight was first contemplated, the prospective pilots conferred with the Chief of the Weather Bureau at Washington to ascertain what simultaneous weather conditions might be expected over such a large area, to receive information and data regarding the speed and direction of prevailing winds, and to get expert advice respecting the most logical starting point, whether from the east or west coast.

Weather maps over a period of years showed an average wind velocity from west to east during the month of October of 22 miles per hour. Taking this fact into consideration, the chief forecaster, Major E. H. Bowie, recommended that the direction of flight be toward the east, even though the distance to be traveled was considerably greater.

Deciding on the route of flight was the next problem. Topographical maps

Official Photograph, U. S. Army Air Service

THE LOWER END OF NEW YORK CITY SEEN FROM AN AIRPLANE

The conspicuous circular building in the foreground is the Aquarium, in Battery Park. Easily distinguished among the great skyscrapers to the left are the Singer Tower and the Woolworth Building.

Official Photograph, U. S. Army Air Service

A PANORAMA OF BOSTON—AND AMERICAN HISTORY

Many historic sites are shown in this photograph. On the left is Boston's famous "Common." The gridiron roofing to the right is that of South Station, where more trains come and go each day than in any other American station with one exception; yet it closes shortly after midnight. At one corner of the Common is the State House, at the other is Park Street Church, where "America" was first sung in public. The Customhouse tower rises in the vicinity of Faneuil Hall. In the upper left corner rises the shaft of the Bunker Hill Monument.

Official Photograph, U. S. Army Air Service

THE GIANT MONOPLANE "T-2" ON ITS RECORD-BREAKING, TRANSCONTINENTAL, NON-STOP FLIGHT

and maps of the U. S. Geodetic Survey were studied and the elevations of the different regions of the United States considered with respect to the time of these localities from our starting point.

ARRANGING MAPS FOR THE FLIGHT

The next step was to prepare our maps. Ordinary political maps were used—one for each State over which we would cross, a total of thirteen.

In addition to these, very large contour maps of the United States were made, showing the entire course across the continent. One of the large maps was pasted on the wall, in the rear of the cabin, and the other rolled up as a strip and carried by the pilot flying the plane, as a check on the more detailed State maps. Each 100 miles along the route was indicated, and the hours from the starting point, if the plane flew at an estimated speed over the earth, were also plainly marked. Compass variations along the line of flight were indicated, for we encountered some as high as 27°, necessitating compass correction continually.

We first made up the big maps of the

Official Photograph, U. S. Army Air Service

QUINCY, MASSACHUSETTS, AND A CHURCH OF THE PRESIDENTS

Once famed for its Revolutionary statesmen, and later for its granite, Quincy was industrially prominent in the World War because of the Fore River shipyards. The church in the square is the Stone Temple, built of granite from property deeded to the town by John Adams, with a presidential pew which was occupied by John Quincy Adams and also by Charles Francis Adams, American Minister to England during the Civil War.

entire route and then transferred it to the more detailed State maps. The line of our course across these State maps was cut every ten miles by a short red cross-line.

Cities, rivers, mountains, lakes, and railroads are the primary ground aids which permit a pilot to check and keep his course. For example, the line drawn across the map would pass very close to a city; then the junction of three railroads; then near a trunk-line railroad bridge crossing a river, and then to another city.

If the distance between the cities was 50 miles and we flew it in 30 minutes, our plane was making 100 miles per hour ground speed, or ten miles in six minutes. Time and compass combined, when used in connection with our maps, gave us our location.

By estimating our time in a certain direction from our last known point, we knew where we should be and looked for the city, lake, railroad crossing, or other ground check. If we found that we were a bit to one side of where we should be, we would correct for this difference in

Official Photograph, U. S. Army Air Service

AMERICA'S OLDEST INSTITUTION OF LEARNING: HARVARD UNIVERSITY

The largest, white, rectangular building is Widener Library, erected in memory of a victim of the *Titanic*. The small structure opposite the church, on the left, is the venerable Massachusetts Hall, used as a barracks during the Revolutionary War. The churchlike structure where the streets form an acute angle, to the upper left, is the Memorial Hall to Harvard men who fell in the Civil War. Along the lower right is a street faced by apartmentlike buildings, known as the "Gold Coast," where many of Harvard's wealthy sons live. To the extreme right, on a line with Widener Library, is the famous Harvard Union, a student club. Adjoining Massachusetts Hall is The Yard, where thousands of distinguished Harvard men have attended commencement exercises. In the extreme upper left are the laboratories. The oval in the foreground is Harvard Square.

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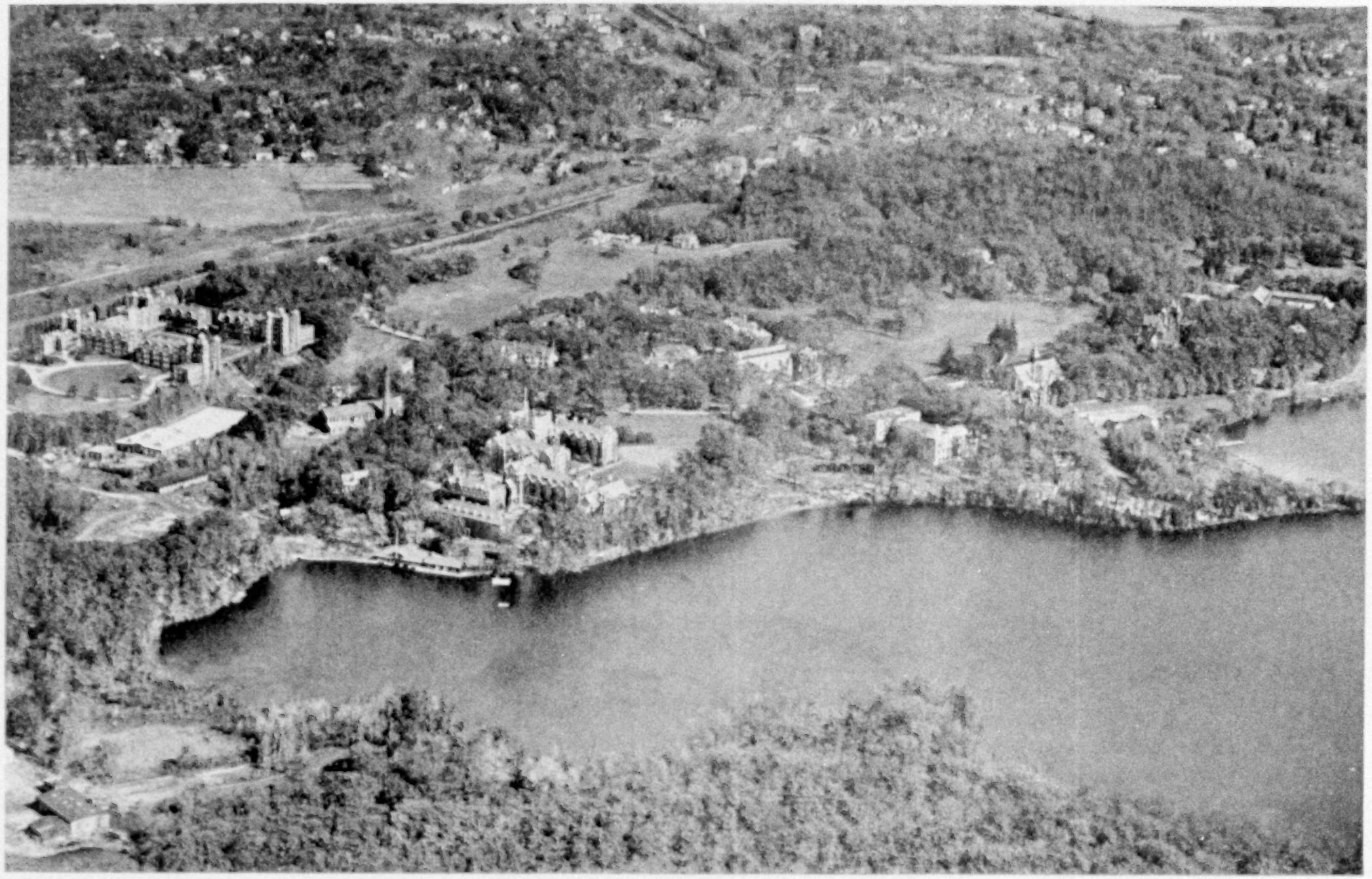
Official Photograph, U. S. Army Air Service

THE LARGEST SCHOOL OF ITS KIND IN THE UNITED STATES VIEWED FROM THE AIR: THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY, CAMBRIDGE



Official Photograph, U. S. Army Air Service

THE AËRIAL CAMERA DISCLOSES THE SYLVAN CHARM OF THE WELLESLEY COLLEGE CAMPUS: WELLESLEY, MASSACHUSETTS

flying to the next point. In this way we kept along a straight line.

The State maps were folded around and separately held to a flat wooden board by elastics. The board was held on the lap when flying, with the State over which we were traveling before us. When we finished with a State, we tore it out and had the next State to look at.

Experiments and tests were necessary to determine the best gasoline and oil to use. California gasoline was used on both flights. It has natural properties which prevent detonation. The gasoline for the east-to-west attempt was shipped by express and truck from San Diego to New York.

Many oils were tested, and we learned that there is great difference in them, some of the best-known oils being of inferior quality.

There were innumerable other details to work out in preparation which I shall not bother to mention, as I know the readers are anxious to get up in the air and start across. All right. Let's go. Contact!

THE FIRST ATTEMPTS

Kelly and I expected to fly out to San Diego, arrive about ten days before the full moon, and during that time take a few sun baths on the beach at Coronado and a goodly number of swims in the Pacific in order thoroughly to rest and relax before undergoing the ordeal of the transcontinental flight.

We had pictured ourselves diving through the breakers or lolling on broad verandas, with our feet on the balustrade, and giving any wandering society belles a treat by telling them what great men we were (Kelly and I were both unmarried then), when the thermometer was registering 102° in the shade at El Paso; but these dreams came to naught on arrival in San Diego.

Our work was just beginning. In Dayton we had the entire Engineering Division behind us. In San Diego, although great kindness and courtesy were accorded us, the problems were such that we had to handle them ourselves.

We found that one of the requirements for a long flight is to do the immediate preliminary work yourself and get dog-tired before starting. It was necessary to install a new engine, prepare the plane in general for the long trip, and clear a two-mile runway across North Island in the direction of the prevailing wind, in order to provide an ideal take-off, as the flying field had been inactive for several years and was covered with clumps of bunch grass and small hummocks of sandy soil.

Telegraphic reports were being received twice daily regarding weather conditions across the continent. There would be a full moon on October 5.

Wednesday, October 4, at 8:30 p. m., the following telegram was received from the Weather Bureau, Washington, D. C.:

> Generally clear sky Thursday night San Diego to Mississippi River and possibly cloudy sky further east considerable cloudiness possibly east of Appalachian Mountains Friday stop Moderate possibly fresh west or southwest winds San Diego to New Mexico and southerly New Mexico to Appalachian Mountains surface and moderate to fresh southeast aloft stop East of Appalachian Mountains winds will be moderate variable at surface and moderate west to northwest aloft on Friday.
>
> MITCHELL.

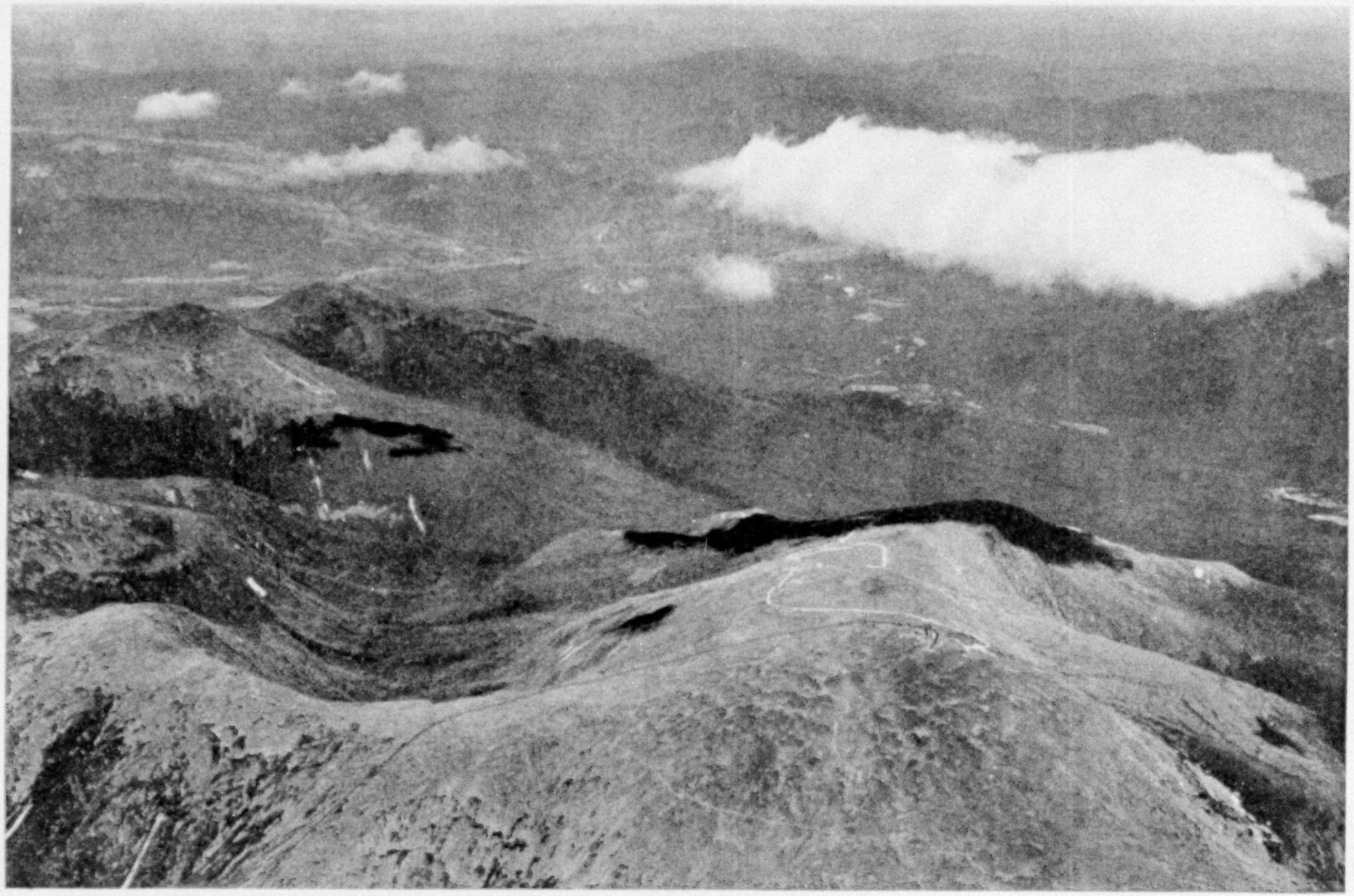
These conditions were almost ideal, when considered over such a long route; the airplane was in a position to fly, and all preparations had been made that evening for a start at daybreak the next morning.

BREAKING THE WORLD'S DURATION RECORD

We arrived at Rockwell Field just before dawn. There were high fog clouds overhead, but who would think of bad weather in California interfering with the flight? A coin was flipped to decide who would take the plane off the ground and fly during the first period. Lieutenant Kelly won the toss, after which the engine was started, warmed up, and block-tested. Everything functioned satisfactorily; the blocks were removed and the throttle applied.

We had been doubtful about the take-off. Although the estimated performance gave a small margin, the smallest error in design or figures would have caused the *T-2* to remain on the ground.

The airplane hesitated and did not immediately move. I began to wonder



Official Photograph, U. S. Army Air Service

MOUNT WASHINGTON, NEW HAMPSHIRE, LOOKING EAST FROM AN ELEVATION OF 18,000 FEET

At the left is Mount Jefferson; in the distance are the towns of Berlin and Gorham. The thin black line winding up from the lower left corner is the cogwheel railroad to the summit of Mount Washington. The white ribbon of automobile road is seen meandering along the top of this, the loftiest peak of the New England States.

whether we had come all the way across the continent to find that the plane would not even move on the ground with the heavy load. It began to move very slowly forward, plainly showing the enormous weight that it was attempting to lift.

After a run of a trifle less than a mile the airplane slowly lifted from the ground and continued very gradually to gain altitude, until a left turn was made to avoid hitting Point Loma. After this turn down wind the airplane started to settle and continued to do so, despite all efforts of the pilot, until dangerously close to the ocean.

Two complete circles of the island were made before an altitude of 200 feet was reached and the nose pointed in the direction of the proposed transcontinental non-stop flight.

NO WISH TO COMMIT SUICIDE IN A FOG

Temecula Pass is 50 miles from San Diego. The *T-2* had slowly and carefully obtained an altitude of 1,700 feet when the pass was reached. Here fog was encountered. This at first did not appear dangerous and the climb was continued. We dived blindly into the white mass and came through the cloud and pass with a short stretch of lower, open, rolling country ahead.

From Temecula Pass the route was almost northeast of San Jacinto; then over a narrow stretch of mountains and foothills to Banning, at an elevation of 2,700 feet.

Banning is at the rough, broken upper end of a valley which descends to below sea-level in Salton Sea, north of Imperial Valley. Trouble would be over if this high point could be negotiated.

Between Temecula and San Jacinto the terrain slopes gradually up to the north and is dotted with mounds or foothills. The route was continued until a point near San Jacinto was reached. Here the ground extended into the fog.

Kelly and I were a couple of young fellows who enjoy living to the fullest extent and we had absolutely no intention of committing suicide. To attempt to fly through those winding mountain passes at a speed of 100 miles per hour, with a heavy, loggy plane loaded to capacity, in a fog so dense that one could not see 50 feet ahead, would have been about the same as putting the muzzle of a loaded gun up to the side of your head and pulling the trigger.

After dodging the foothills for one hour, hoping that the fog would dissipate or break, and with little apparent chance of getting through the more rugged and higher country ahead, it was decided to return to Rockwell Field and try for the world's endurance record for airplanes.

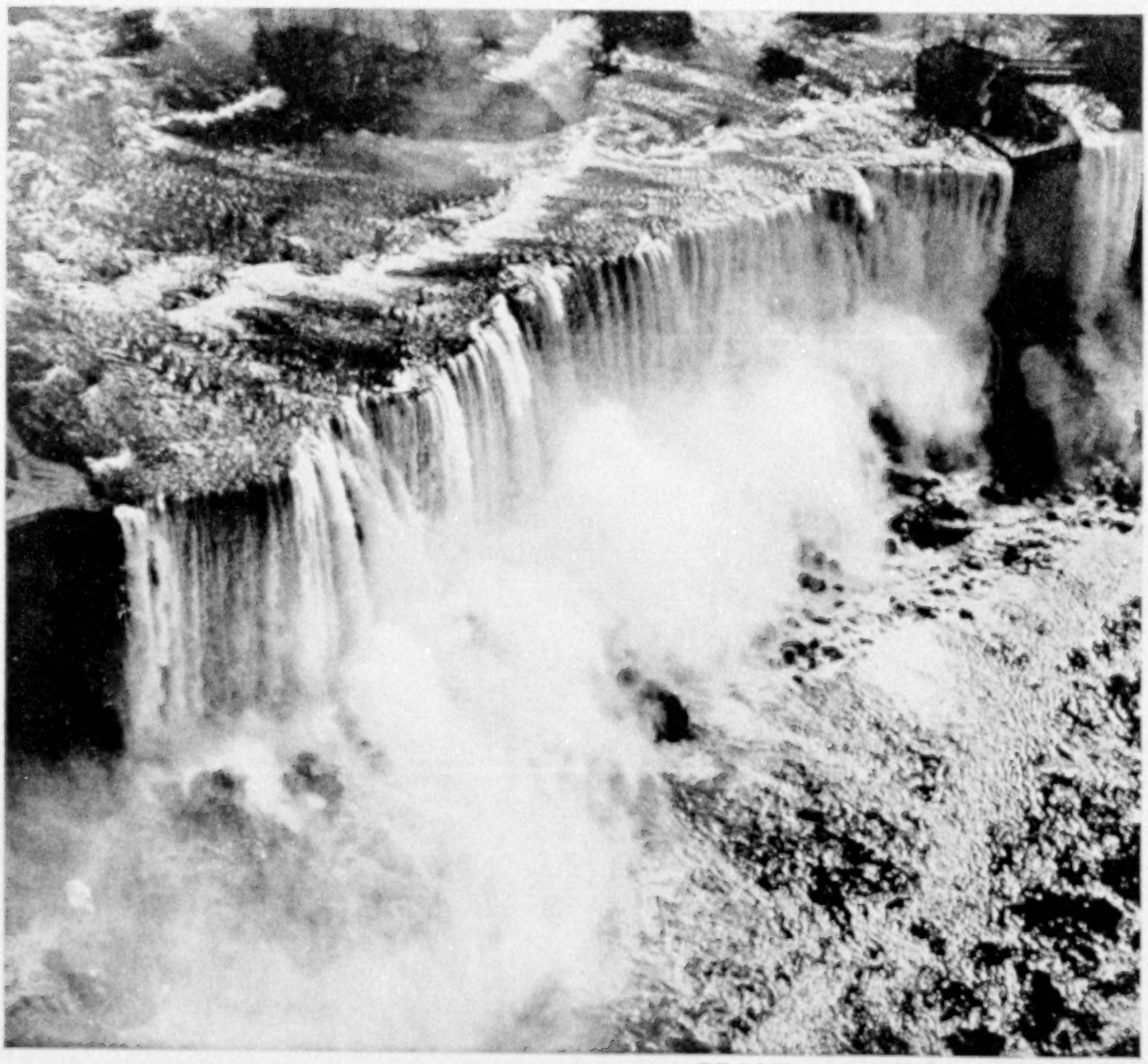
This decision, though hard to make, seemed the only sensible thing to do. The hour's delay north of Temecula meant that the *T-2* would not be out of the mountain passes of New Mexico before dark. The gasoline supply had also been wasted, thus impairing the chance of reaching New York.

The endurance flight would provide a means of securing reliable information regarding gasoline, water and oil consumption, and data on the performance of the airplane when loaded. This last was especially desirable, as it would be necessary to reach an altitude of 6,800 feet at Santa Rosa, New Mexico, after nine hours' flying. There was also the uncertainty of landing the transport with this load.

However, the primary reason for staying in the air for two long days and a night was because we did not have the nerve to return to San Diego at once after being hand-shaked, slapped on the back by many friends, and started for New York with all proper ceremony and éclat.

On returning to Rockwell Field, the following message was dropped:

> CAPTAIN R. G. ERVIN,
> *Commanding Officer, Rockwell Field:*
>
> Impossible to get through mountain passes with heavy load on account of dense fog at ground and aloft. An hour and a half wasted in attempting to get through, with no sign of clearing. Cannot now reach the high altitudes south of Tucumcari, New Mexico, by nightfall. We are attempting to break the world's endurance record for airplanes and will make the transcontinental non-stop flight later. Please get in touch with the representatives of the National Aëronautical Association and take the steps necessary to authenticate a world's airplane endurance record, should the attempt prove successful, and also wire this information to the Commanding Officer, McCook Field.
>
> MACREADY.



Official Photograph, U. S. Army Air Service

AS THE AIRMAN SEES THE AMERICAN FALLS AT NIAGARA

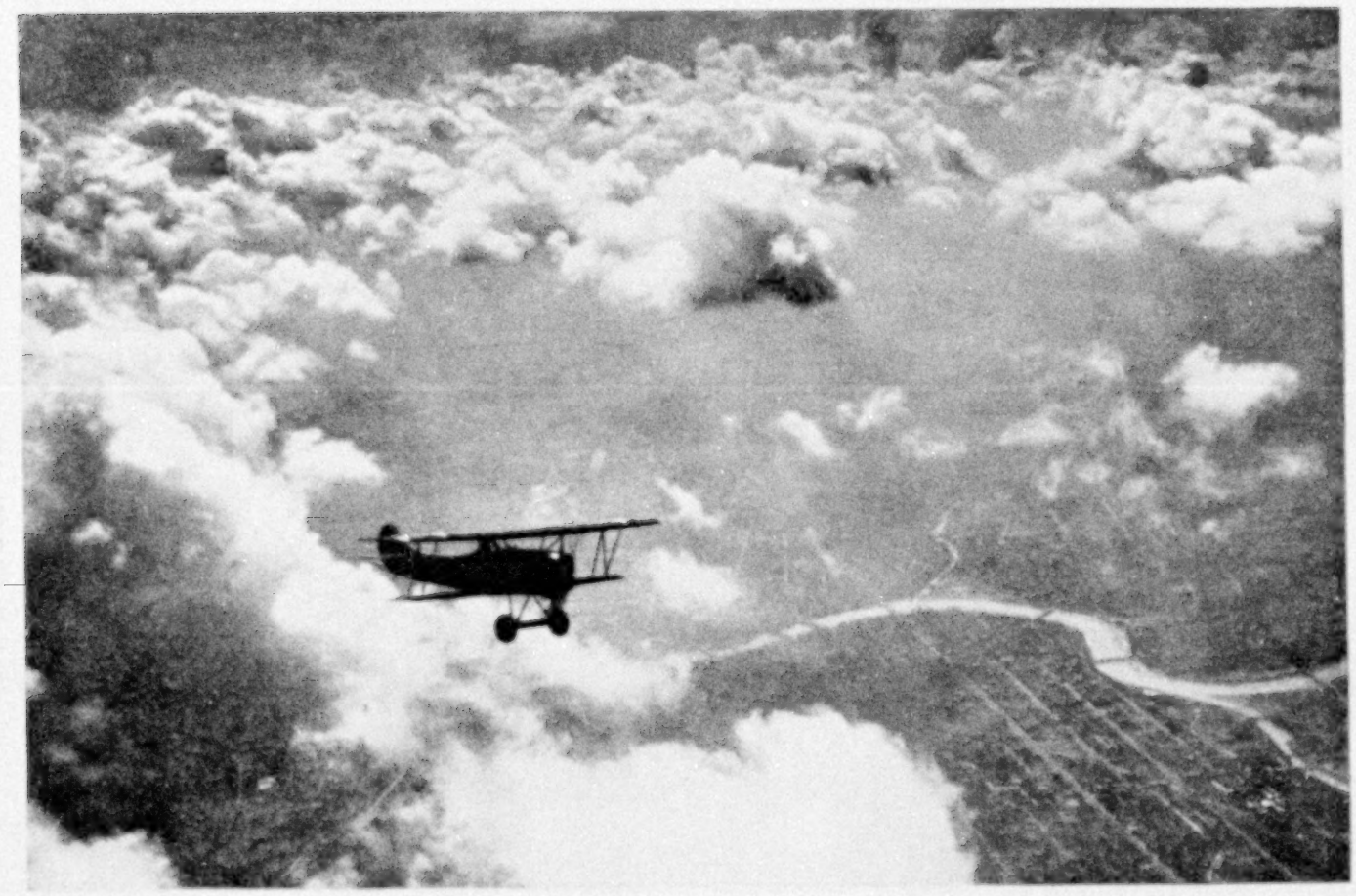
This portion of the famous scenic wonder lies within a State park, one of the rapidly multiplying reservations which Commonwealths are setting aside for the tourist, the camper, and the nature-lover. It marks the first place in the United States where condemnation proceedings were employed for the sole object of preserving scenery.

San Diego is the ideal place to make endurance flights. Compared to all other flights of the *T-2*, this was by far the easiest—in fact, there was but little hardship and practically no danger in connection with it, except during the first two hours, when battling the fog and elevations around San Jacinto. At night we could always stay within reasonable distance of a landing place, and with the bright moon overhead it was really a pleasure to fly.

There was no worry or anxiety concerning our personal safety, fatigue being the only element to consider. Any one can approximately picture this fatigue by imagining himself on an uncomfortable seat out in a vacant lot or street, with the wind blowing about 100 miles per hour, and with legs and arms held out continually in the same position, controlling a big, heavy plane weighing over 10,000 pounds, for two long days and a night.

HOW THE PILOTS SHARE THEIR WORK ON NON-STOP FLIGHTS

The pilot of the *T-2* sits high up in the nose of the plane, with the engine by his side and partially under his right arm. Minor repairs can be made by the pilot in flight. There is another control about ten feet in the rear, but it is extremely diffi-



Photograph by Samuel M. Burka, of U. S. Army Air Service

A FOKKER PLANE ABOVE THE CLOUDS AT DAYTON, OHIO

cult to fly from behind, as the pilot can only see out of a door at his left side.

Most of the space within the fuselage is taken up with a 180-gallon gasoline tank. Five hundred and fifty-seven gallons of gasoline are carried in the wing.

Communication within the plane was maintained through the use of written messages, transmitted direct by crawling over the wires through the communicating tunnel to the small aperture behind the front cockpit and passing them up by hand.

The pilots took turns of six hours each. Lieutenant Kelly piloted for the first six hours, until noon; I until 6 p. m., and Lieutenant Kelly again until midnight, I until 6 a. m.; Lieutenant Kelly until noon the second day and I until dusk, when the airplane was landed.

On the completion of six hours at the controls in the front cockpit the pilot would signal energetically, by shaking the wheel, for the pilot in the rear to take the controls, and when satisfied that everything was functioning satisfactorily, would open the small door to his rear, pull out the back of the pilot's seat, and drop it on the floor through this hole, together with the parachute and cushion.

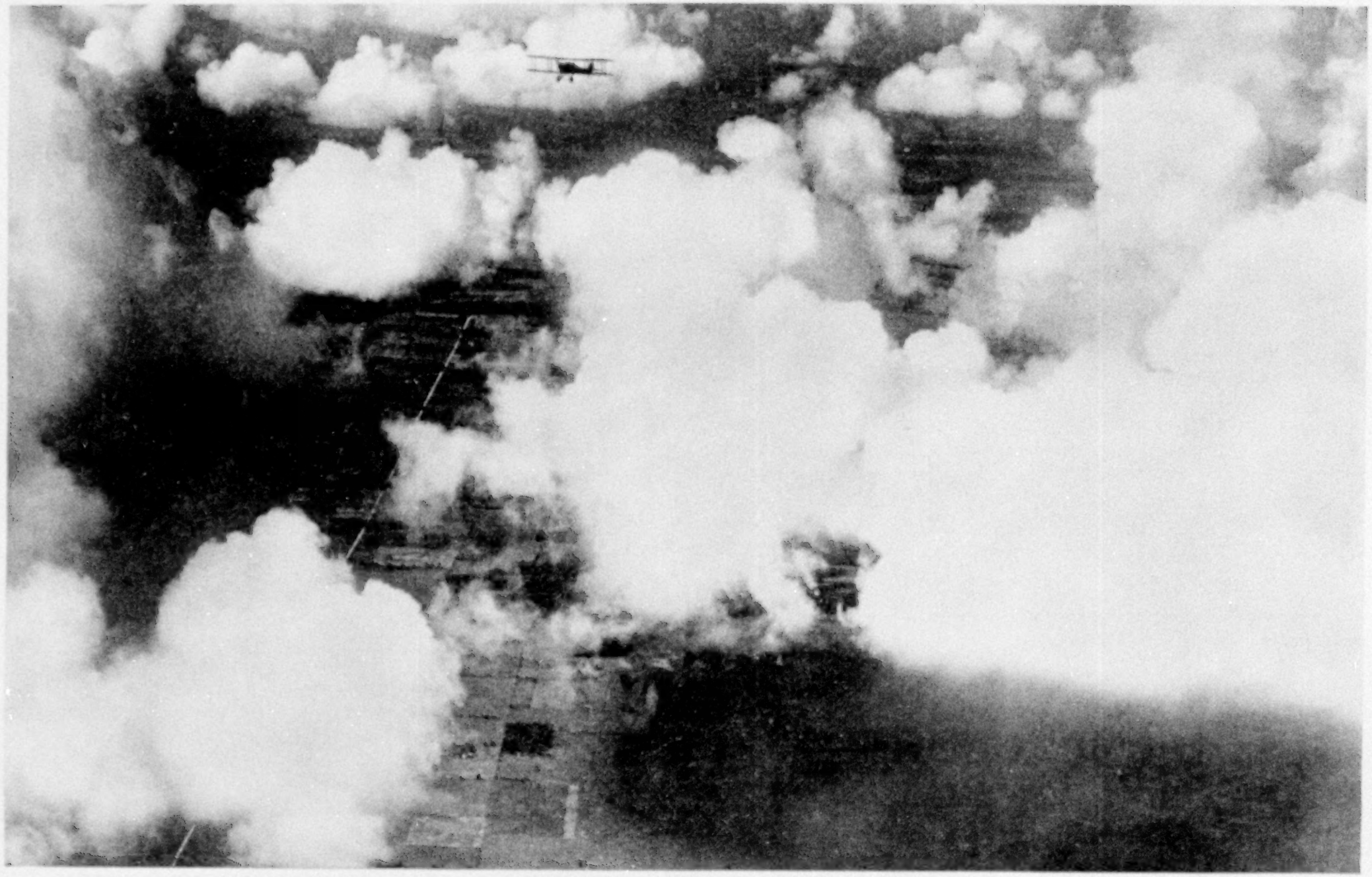
Lifting up one side of his hinged seat, he would crawl through this small door and back through the narrow passageway paralleling the gas tank to the rear pilot. By yelling in a very loud voice, the pilots could converse in the rear, one being at the controls and the other seated alongside.

After placing the plane in a safe flying attitude, the change at the wheel was made by the active pilot quickly stepping out and forward and the new pilot sliding in from the rear.

Crawling up over the wires through the tunnel and into the front seat, the pilot on duty took the controls and flew the plane, the other pilot placing the parachute cushion and seat back in position. Five changes were made, one being accomplished at midnight without light.

NO SLEEP FOR EITHER FLYER DURING ENTIRE 35 HOURS

Although it had been expected that the pilot off duty would be able to sleep and relax for short periods, neither pilot had any sleep.



Official Photograph, U. S. Army Air Service

FLYING AMONG THE CLOUDS ABOVE DAYTON, OHIO

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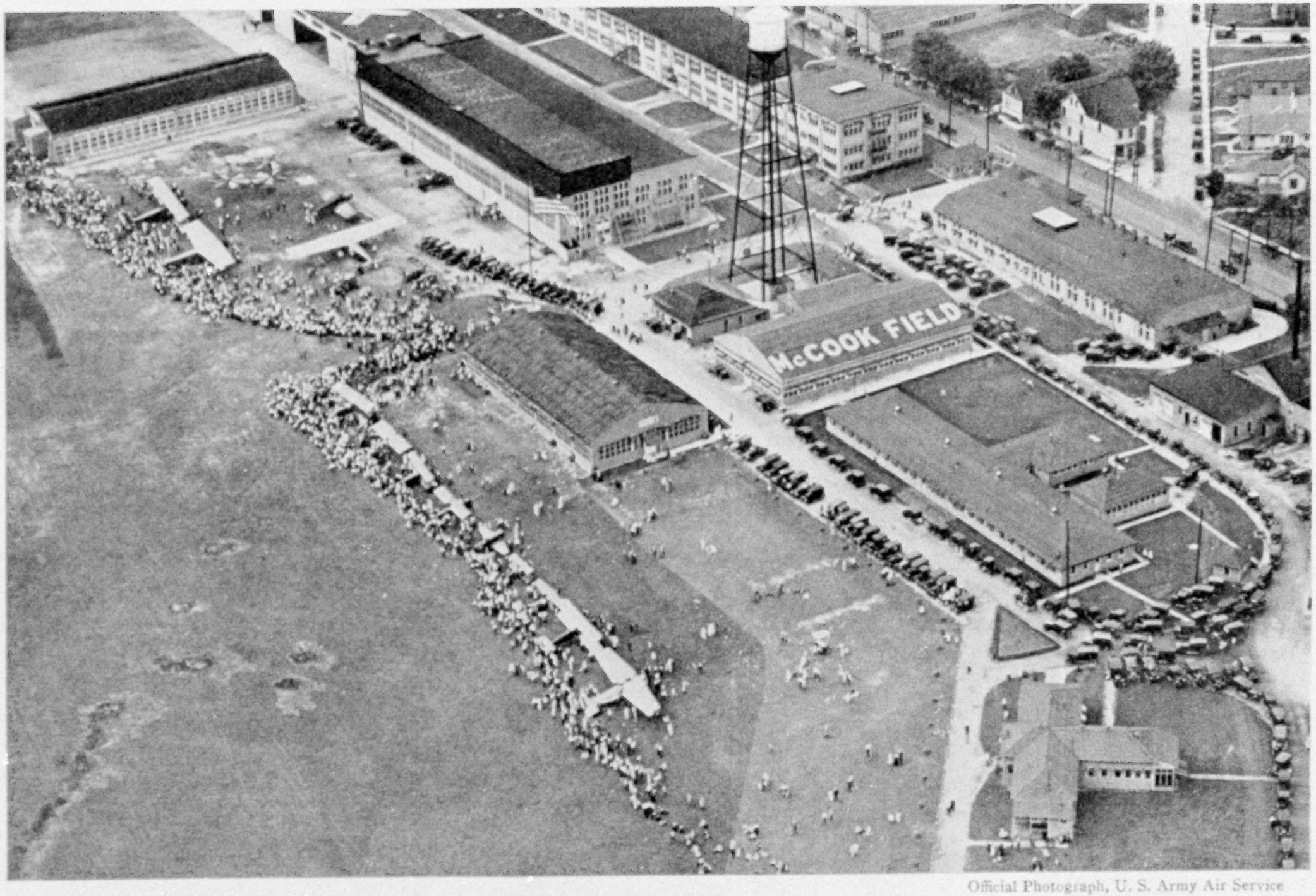
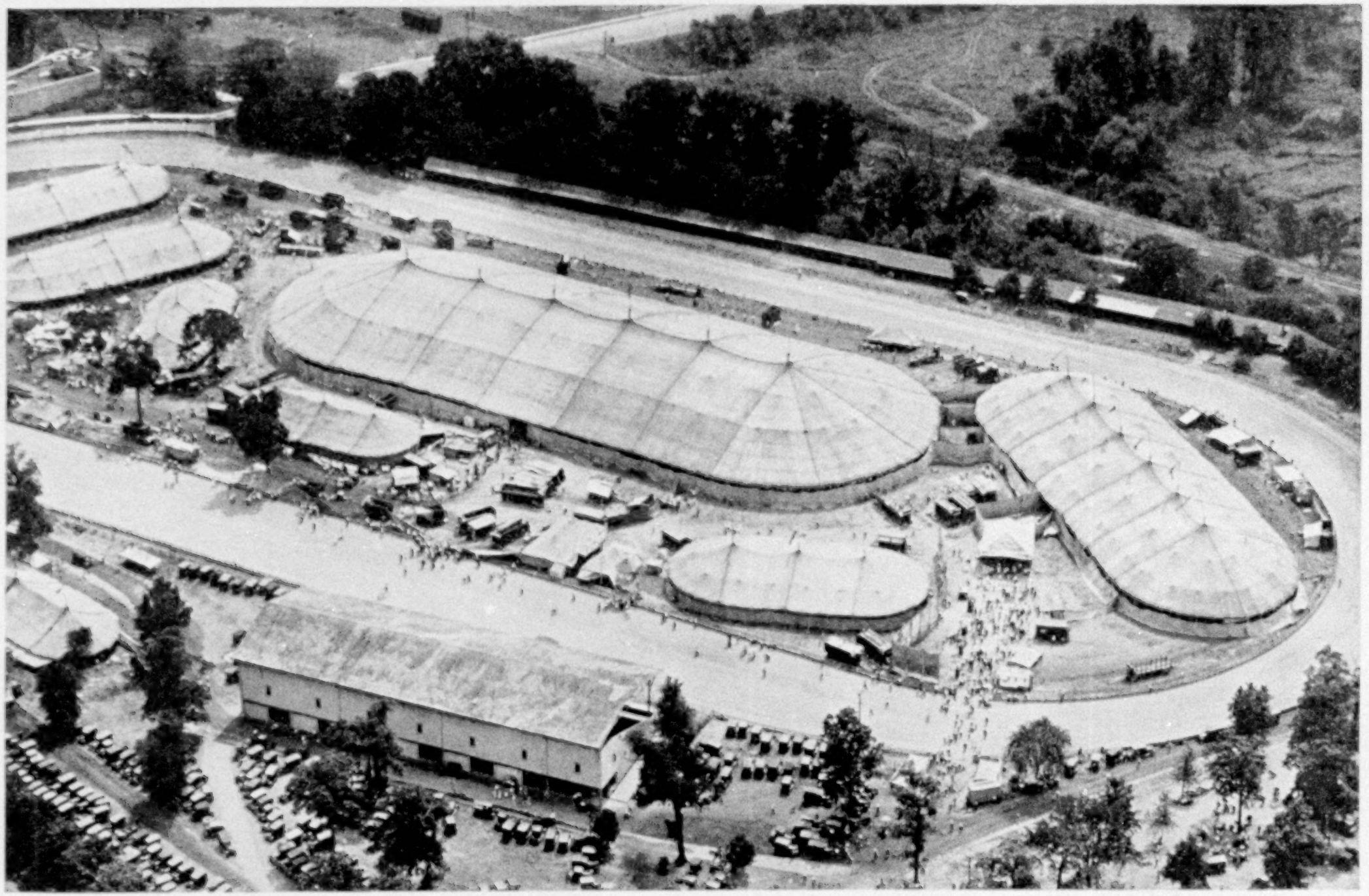


Official Photograph, U. S. Army Air Service

MCCOOK FIELD, NEAR DAYTON, OHIO, IS THE AVIATOR'S LABORATORY

At this test field of the Engineering Division, U. S. Army Air Service, new devices are tried out. Notable among the experiments now in progress are those with the helicopters. New airplanes are tested out here before being put into the service. Dayton was the starting point for the Stevens-Macready photographic expedition (see page 85).



Official Photograph, U. S. Army Air Service

HOW THE "BIG TENT" LOOKS FROM THE SKY: A CIRCUS ON THE FAIRGROUNDS AT DAYTON, OHIO

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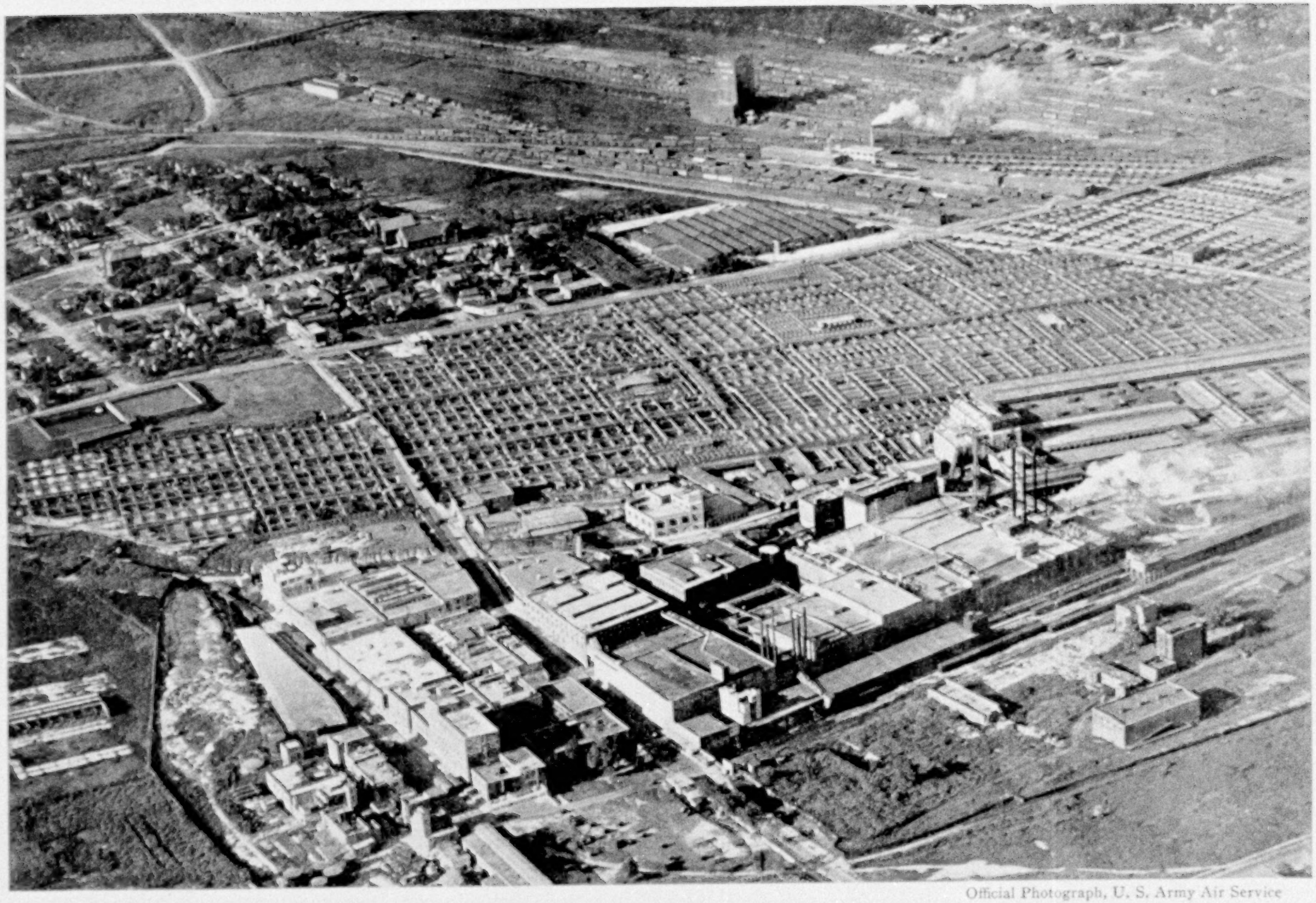
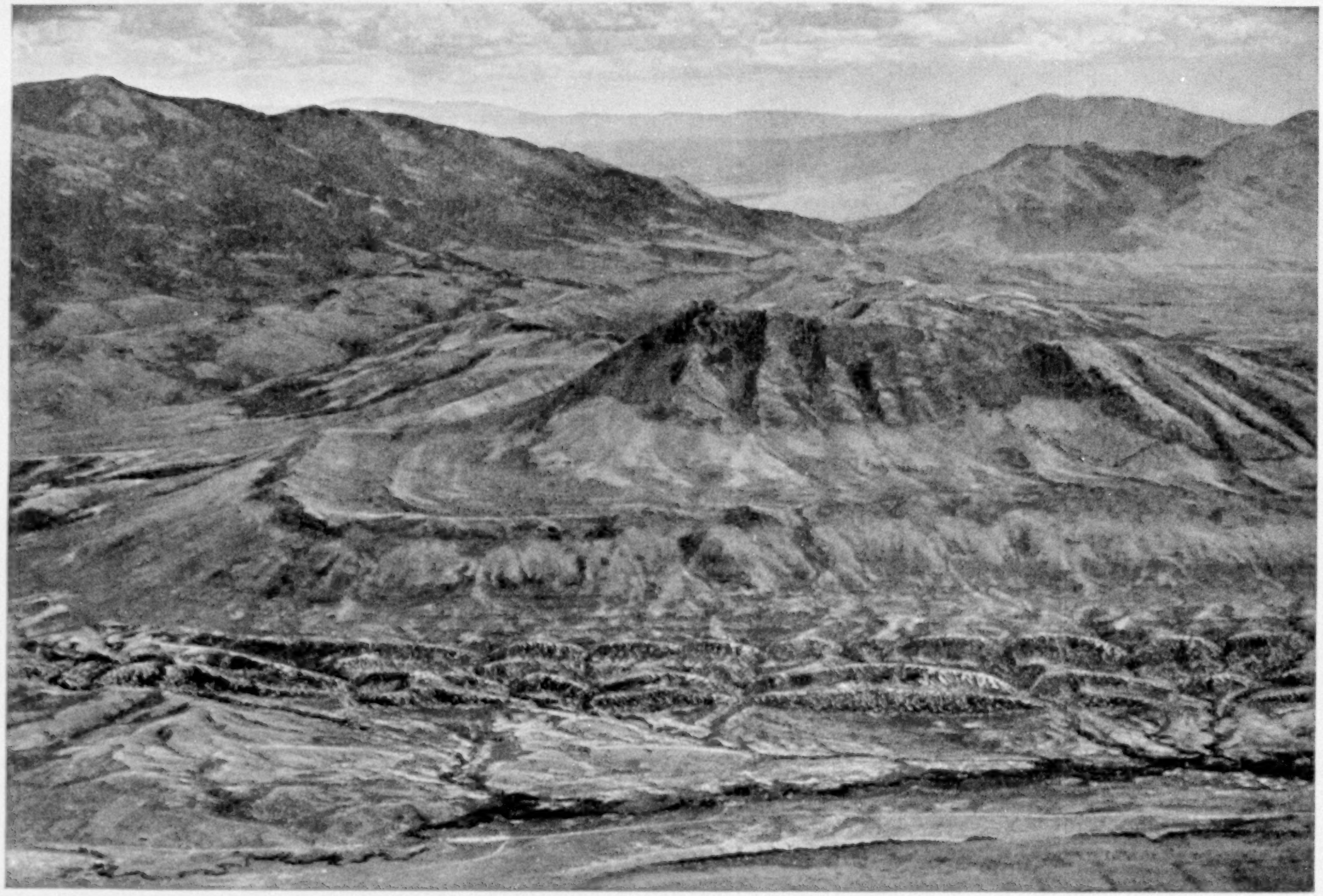


Official Photograph, U. S. Army Air Service

THE STOCKYARDS OF OMAHA, NEBRASKA, SEEN FROM ABOVE

Once the beginning of the Indians' western trail, later of the white man's migration to California and Oregon by stagecoach and ox team, Omaha, on the Lincoln Highway, to-day is the "Gate City of the West" by virtue of being a railway center for the vast empire to the west and a main station for the coast-to-coast mail flyers. It is the second live stock and corn market of the world.



Official Photograph, U. S. Army Air Service

THE BOLD WESTERN SLOPES OF MEDICINE BOW RANGE, WYOMING, FROM THE AIR

These mountains opposed an obstacle to the covered wagons of the winners of the West. The early settlers of Idaho and Oregon had to make a toilsome detour around them. To-day air mail planes speed across southeastern Wyoming in their daily coast-to-coast relay flights.

Some relaxation was obtained, but there were so many details, such as minor maintenance and repair of engine and plane, relief of the pilot in front for brief periods, inspection and check of gas, oil, and water consumption, dropping of messages, nourishment, and general coöperation, that the time of the relief pilot was of considerable use and could not be taken for rest.

The food supply for two long days and a night consisted of a box of sandwiches, a half-gallon thermos bottle of strong hot beef broth, and a half-gallon thermos bottle of very strong, hot coffee. The broth and sandwiches were used to provide strength and to sustain, and the strong coffee as a stimulant to keep the pilots awake.

The night was cold. Before going on shift, the pilot would drink some hot broth, eat a sandwich, and swallow several drafts of the strong coffee, after which he felt in very good shape for the ensuing six hours at the helm.

The night was clear and the moon full. Just before daybreak a low fog bank came in from the ocean and totally obscured the ground for a couple of hours.

When nightfall of the second day approached and it appeared that the gasoline was about used up, the plane was kept in position for a forced landing on the field. Nightfall and final gas consumption would apparently be about simultaneous.

Rather than have a forced landing in darkness, in the pilot's fatigued condition, for the sake of a few minutes' additional time, a landing was made at dusk, in order to avoid possible damage to the plane, it being realized that the primary object of the *T-2* was the accomplishment of a transcontinental non-stop flight, and that the endurance record was incidental to this.

WORLD RECORD BROKEN BY OVER EIGHT HOURS

The *T-2* had remained in the air for thirty-five hours and eighteen minutes, breaking the world's duration record by more than eight hours.

Although naturally very tired toward the finish of the test, neither pilot was in bad shape physically. All faculties, physical and mental, functioned normally throughout the flight. In fact, before leaving the plane after taxiing to the line and after the first excitement of welcome, steps were taken and orders given by the pilots to get the plane ready for the transcontinental non-stop flight from San Diego to New York, as it was very much desired to start this cross-country flight during the period of moonlight then existing, and it was the intention on landing to start on the long flight within two or three days after the accomplishment of the endurance record.

However, more maintenance was necessary than was anticipated and ensuing unfavorable weather made this impossible.

WATCHFUL AND EXASPERATING WAITING

After October 10 there was practically no moon. Had all weather conditions and winds been ideal, the pilots would have attempted the flight during this period of total darkness, as the cold of winter, long nights, and uncertain weather were hazardous.

All was in readiness to start on short notice; in fact, two starts were anticipated during this time, and the airplane was brought out at night to the end of the runway with the expectation of a take-off in the morning; but later weather reports were unfavorable and it did not appear good judgment to leave under such conditions.

This period of waiting was a trying one. Few individuals enjoy good soft beds and good square meals more than Kelly and myself, but this was not the time to be loafing around San Diego, and we were getting desperate.

Every time we stepped into an elevator at our hotel some one would ask us when we intended to start.

It was all right for a week or so after the duration record, but later on, when the sun would be shining brightly in San Diego and Kelly and I would be making no apparent effort to go, we imagined that people would wink at their friends and say, "Those two birds know a good thing when they get it. They haven't any idea of trying to get across this old continent. They'll spend a nice soft winter in San Diego and fly back by easy stages, when it's too late to make the non-stop."

They did not realize that at that minute there were rainstorms in the Middle West

Official Photograph, U. S. Army Air Service

WHERE THE AIR MAIL LANDS AT ROCK SPRINGS, WYOMING

The town is in the foreground and the air mail landing field is in the upper right corner. It was upon the slope in the upper left corner that the mail plane shown on page 114 crashed.

and in the mountains and high elevations that we would cross in darkness.

The moon became noticeable about October 28, and from this date the forecasts were watched very closely. However, the weather at this period was extremely unfavorable throughout the entire route, making a start impracticable.

A study of weather conditions during the period of waiting in San Diego disclosed the fact that a very important feature had been overlooked. It was very true that an average wind velocity from west to east of 22.5 miles per hour prevailed during the fall, but other unfavorable elements were combined with this factor, entirely obliterating its value as a beneficial agent.

Winds blow in to fill up an area of low pressure and blow out from an area of high pressure.

An area of low pressure is usually a storm center, while an area of high pressure indicates good, clear weather. These areas usually drift, with various deflections, in a general direction from west to east. Strong winds of great velocity blow into the low-pressure area, or storm center. A favorable wind for the transcontinental flight would be one blowing into a storm, and a head wind would occur, with good clear atmosphere, as a result of the high pressure. Winds blow in a counter-clockwise direction about a low-pressure area and in a clockwise direction about a high-pressure area.

Official Photograph, U. S. Army Air Service

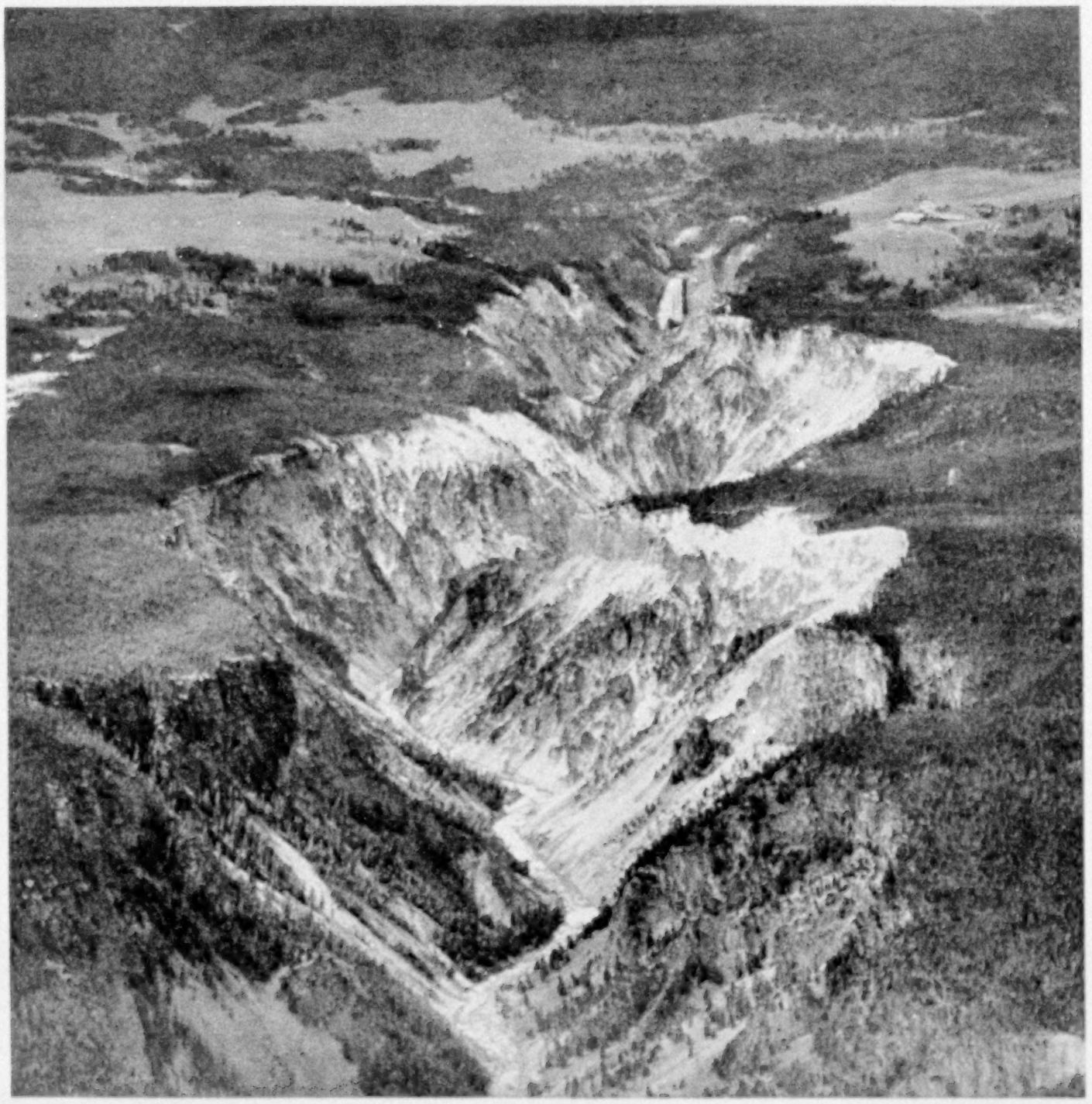
LOOKING DOWN UPON THE TWIN LAKES, TAGGART AND BRADLEY, IN THEIR MOUNTAIN SETTING, JACKSON HOLE, WYOMING

After considerable investigation and study, it was determined that the ideal condition was one where an extreme low-pressure area, with a tremendous draught behind it, had drifted across the continent to a position in the vicinity of New England, with this drift still continuing to the east; another of low pressure to the northeast of the start of the flight, and one of high pressure about midway between the two low-pressure areas and to the south or below the route of the coast-to-coast course. This arrangement would give a condition of wind direction similar to cogwheels, each area tending to wind the winds across.

A report from the chief forecaster at Washington on the morning of November 2 stated that weather conditions would not be propitious for a start within the next thirty-six hours. In the face of these reports, it was not expected that a start would be made the morning of November 3.

A SUDDEN DECISION TO START

But on the night of November 2, the San Diego weather forecaster, Mr. Dean Blake, brought his maps to the quarters of the pilots. Indications were for reasonably favorable weather with favoring winds for practically the entire route. At



Official Photograph, U. S. Army Air Service

LOOKING UP YELLOWSTONE CANYON, WITH YELLOWSTONE FALLS IN THE DISTANCE

In the upper right corner are the long buildings of the Canyon Hotel. The narrow channel of the river winds at the base of the brilliantly colored canyon walls in the central foreground. The clear areas in the distance are among the few spaces in Yellowstone National Park on which it would be possible to make an emergency landing with an airplane.

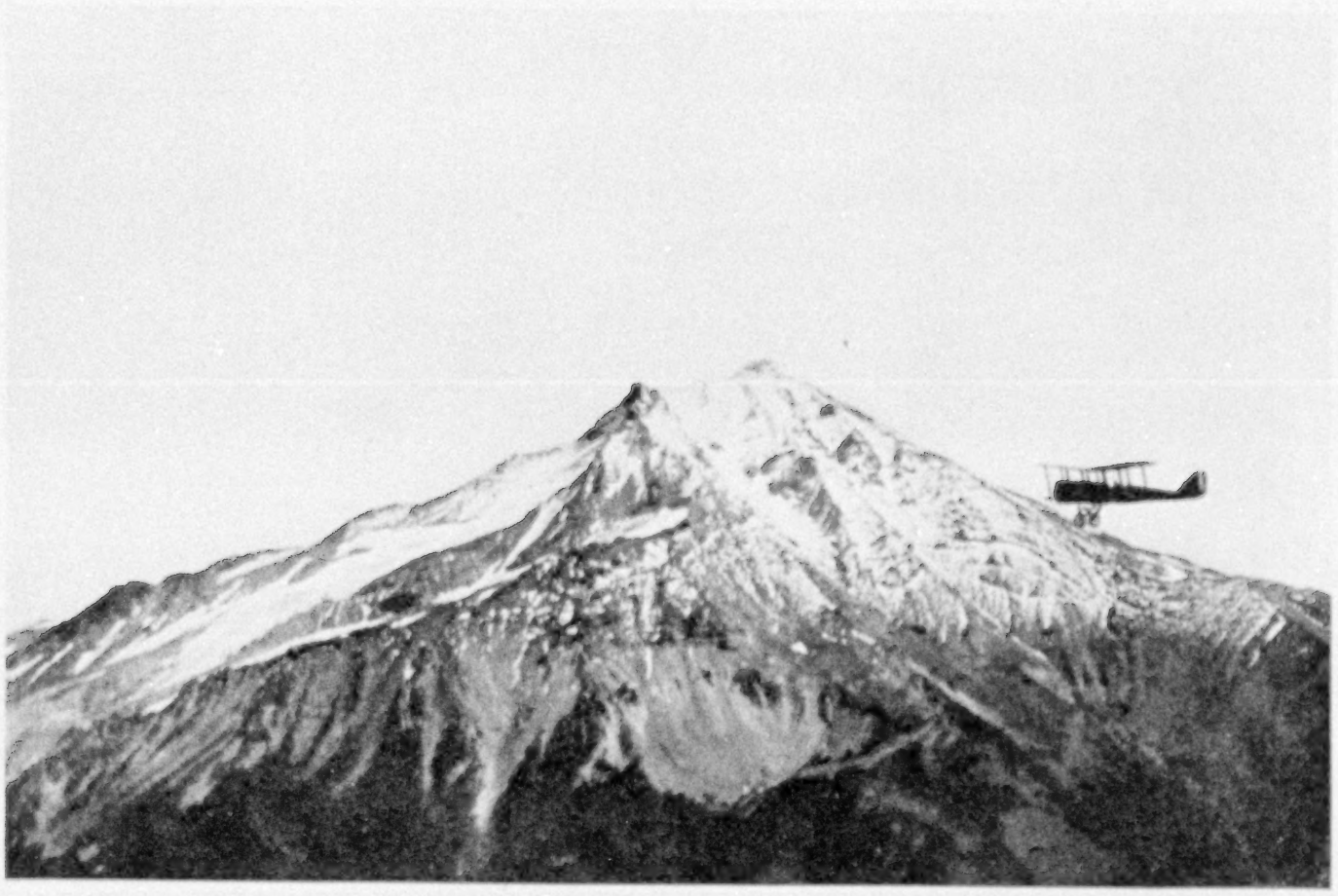
approximately 9 p. m. a report was received from the chief forecaster at Washington as follows:

> Weather conditions propitious for start Friday morning. Saturday conditions will be less favorable.

With the two forecasters agreeing on an almost ideal condition, there was no reason for delay.

I was giving an address to the University Club of San Diego during the course of their annual Duck Dinner, and Kelly received the reports at our hotel. He called me to the phone as I was finishing my talk. He said: "Mac, have you got your passage booked for New York?" I answered that I had my ticket. "All right; we start in the morning. Better get over here right away," he said.

I excused myself and left the dinner at about 9:30 p. m., without intimating our decision. The next morning, when the University clubmen arose from their beds, their morning newspapers informed



Official Photograph, U. S. Army Air Service

TAKING AIRPLANE PICTURES OF A MOUNTAIN

"Just a little to this side, please," says the photographer to the pilot, but the airplane, not the mountain, does the moving. The airplane here shown was not making a nose-dive into the peak, but was circling around for points of vantage when a companion plane's photographer snapped it.

them that Kelly and I were well on our way across the continent. It must have been considerable of a shock to them, as the general consensus of opinion seemed to be that we were settled in San Diego for the winter.

Final preparations for an early start the next morning were begun. It was necessary to gather men and get the huge plane out of the hangar at Rockwell Field in the intervening time between 10 p. m. and daybreak, and check over the airplane and warm up the engine during the night. It was also necessary to complete final arrangements—pay bills, pack, etc.—which made our time of retirement well after midnight. A call was left for 3:30 a. m., permitting approximately three hours' sleep previous to the long trip.

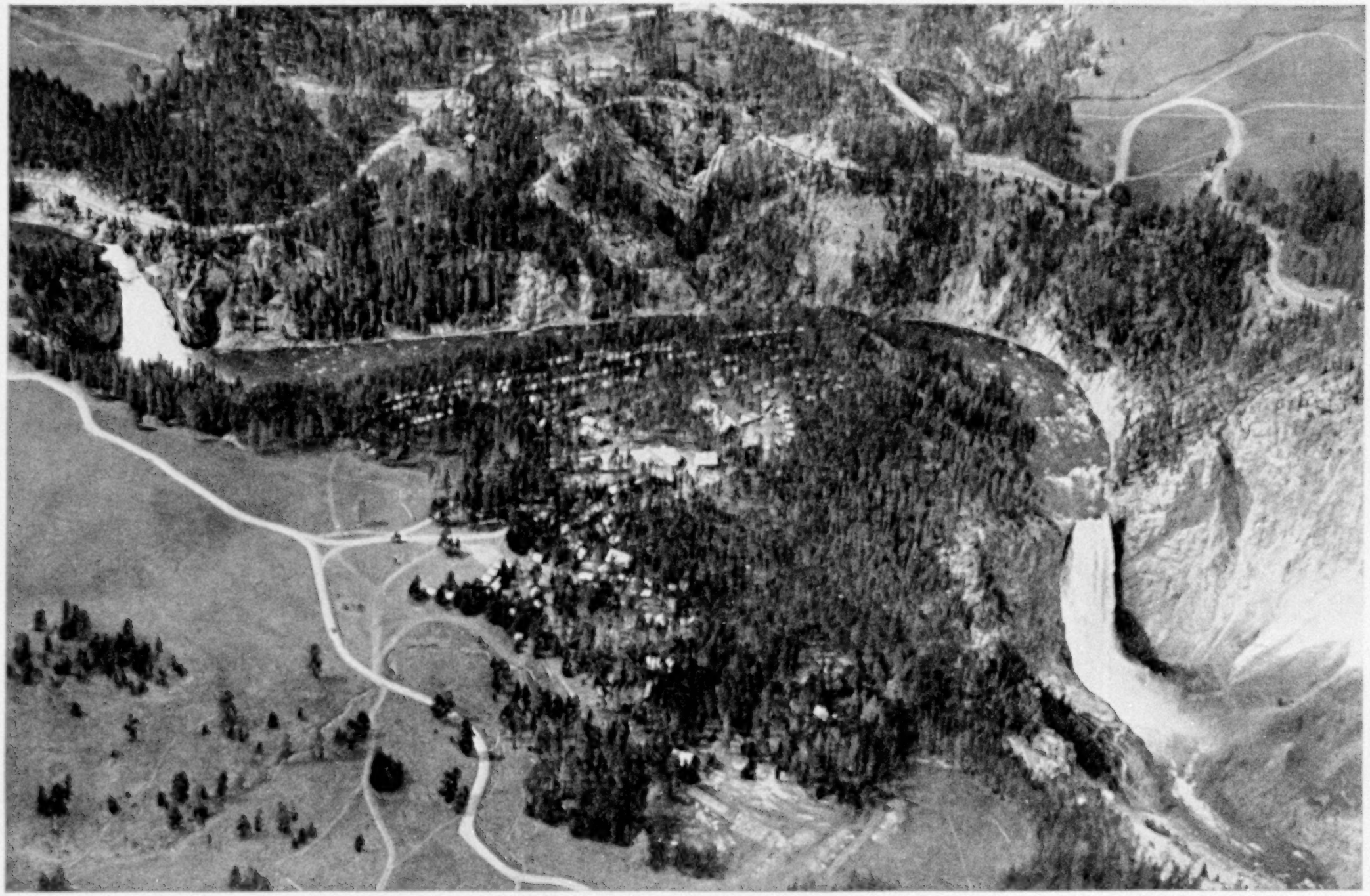
OFF TO A GOOD START

On arrival at Rockwell Field in darkness, at 5 a. m., with food and equipment for the trip, it was found that the plane was on the line ready for the start. It was necessary to await sufficient light for the take-off. The total weight of the airplane was 10,850 pounds, approximately 155 pounds more than had been carried on the previous flight.

The experience of the original start came in good stead at this time, as the airplane was flown for several miles out to sea in almost a straight course, turning only enough to avoid Point Loma. When it became necessary to swing back toward the coast, the turn was very gradual and without loss of flying speed. Two complete turns around North Island were made and the transcontinental nonstop flight from San Diego to New York commenced.

The atmosphere was clear, in contrast to the previous attempt. The *T-2* climbed better than had been anticipated. Temecula Pass was negotiated without effort, as were also the higher mountains in the vicinity of San Jacinto and south of Banning, California.

From an altitude of 2,400 feet at Banning, the country slopes down to below



Official Photograph, U. S. Army Air Service

THE UPPER FALLS AND YELLOWSTONE FALLS, IN OUR LARGEST NATIONAL PARK, SEEN FROM THE AIR

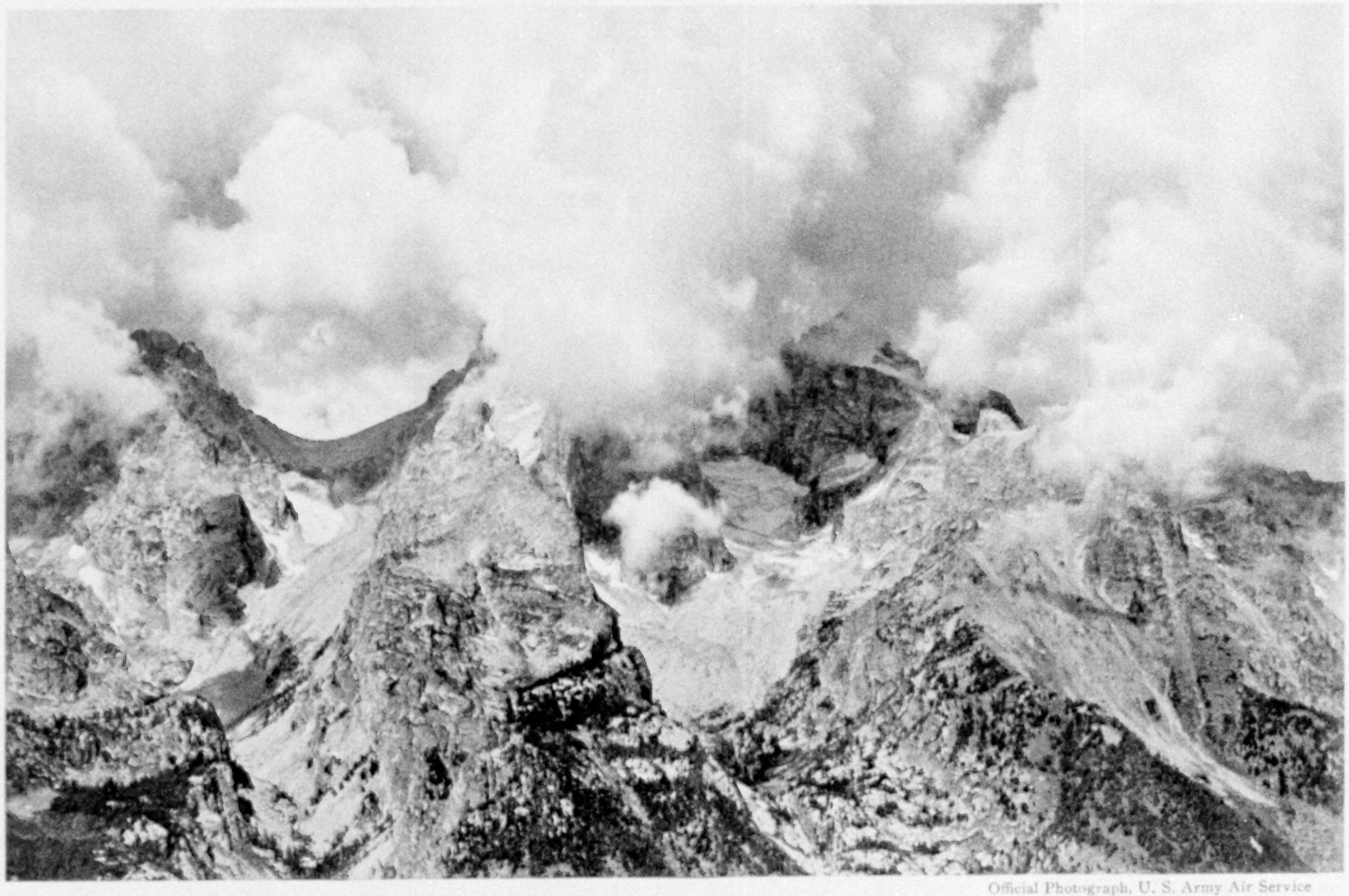
Yellowstone Park, geographically, is a volcanic plateau in the center of the Rocky Mountain system. It has more geysers than are to be found in all the rest of the world; its wooded area almost equals the combined areas of Delaware and Rhode Island; its boiling springs, its sublime canyons, its petrified forests, and its wild life make it one of America's most celebrated natural wonder regions.

XUM

Official Photograph, U. S. Army Air Service

THE BASIN OF THE GIANT GEYSER IN YELLOWSTONE NATIONAL PARK FROM ALOFT

This terrestrial funnel every few days spouts for an hour at a time, throwing water nearly as high as the dome of the United States Capitol. "In the Yellowstone we were particularly impressed by the intense blue of the water in the geyser and hot springs basins and by the vivid coloring of the rims."—*Stevens and Macready.*



Official Photograph, U. S. Army Air Service

THE AËRIAL PHOTOGRAPHERS SENT THEIR PLANE PLUNGING THROUGH THESE GIGANTIC WAVES OF THE CLOUD OCEAN BREAKING OVER THE TETON PEAKS, WYOMING, A MOMENT AFTER THIS PICTURE WAS TAKEN

sea-level at the Salton Sea. The *T-2* passed the Salton Sea at an elevation of approximately 2,000 feet, and instead of going on south through the Imperial Valley to Yuma, a cut-off was made at Niland in an easterly direction to the Colorado River, which was crossed, and the course continued to the Gila River.

The Gila was partially followed, crossed diagonally, and in a short time the Southern Pacific Railroad was picked up and followed. The pilots changed at the Colorado River.

The proposed route would take the *T-2* from Rockwell Field to Banning, California, south to the lower end of the Salton Sea; thence southeast to the Southern Pacific Railroad; thence through Tucson, Arizona, to Deming, New Mexico; northeast to Rincon, New Mexico; north to Estancia, New Mexico; thence to Santa Rosa, New Mexico; Tucumcari, New Mexico; Dalhart, Texas; Guymon, Oklahoma; Wichita, Kansas; St. Louis, Missouri; Terre Haute, Indiana; Indianapolis, Indiana; Dayton, Ohio; Columbus, Ohio; Pittsburgh, Pennsylvania; New York, New York, and Mitchel Field, Long Island. Certain deflections, which are hereafter noted, were made from this route to meet emergencies.

BUMPY FLYING AT LOW ALTITUDES

As the country around Tucson was approached, it became a continuous struggle, with the climb at practically the absolute ceiling of the airplane, in order to cross over the high passes, mountains, and elevations, the passing of each obstacle being doubtful.

The atmosphere was very rough and bumpy, with numerous air currents, which would raise the airplane 100 feet or more at a time, sometimes possibly 200 or 300, and then let it down quickly, even though the same position or angle of climb of the machine was maintained. Many times it seemed that the *T-2* would not be able to get over these high areas, but, apparently just as the summit was reached, one of the air currents coming over the high elevation would raise the airplane just enough to clear the top.

For long periods the *T-2* was flown within 40 or 50 feet of the surface of the ground, more altitude being impossible of attainment. This was especially noticeable over the large plains west of Deming, where a terrific wind from the south was blowing, causing the air to be extremely rough and bumpy. Flying under these conditions, with such a large and heavy airplane, was very fatiguing, as much physical exertion was required.

At Deming an elevation of approximately 5,200 feet was attained. The airplane would go no higher at this point. I had been desirous of passing on to Lieutenant Kelly as much altitude as possible, knowing that an elevation of 6,800 feet would be encountered within the ensuing few hours.

Lieutenant Kelly took the controls after leaving Deming and attempted to follow the original course over the high elevations to the left of the Rio Grande, but after a half hour's flight it was plainly seen that the airplane would run into the ground if a straight course were continued, so he changed the route which had been previously planned and attempted to fly up another valley considerably to the right.

This valley carried the airplane over the deserted alkali dry lakes and the vast snow-white salt marshes of New Mexico, and then over the Malapals, or ancient volcanic lava beds, stretching beneath for 80 or 100 miles like a huge sheet covered with grotesque black tufts and masses. This was a very strange and picturesque part of the flight. The airplane was flown close to the mysterious black volcanic craters.

It is improbable that airplanes have been through this region before, at least at such extremely low altitude, and the appearance of the *T-2* just above the surface of the ground caused great consternation among the Indian tribes living in their mud huts and caves in this barren region of alkali and lava beds.

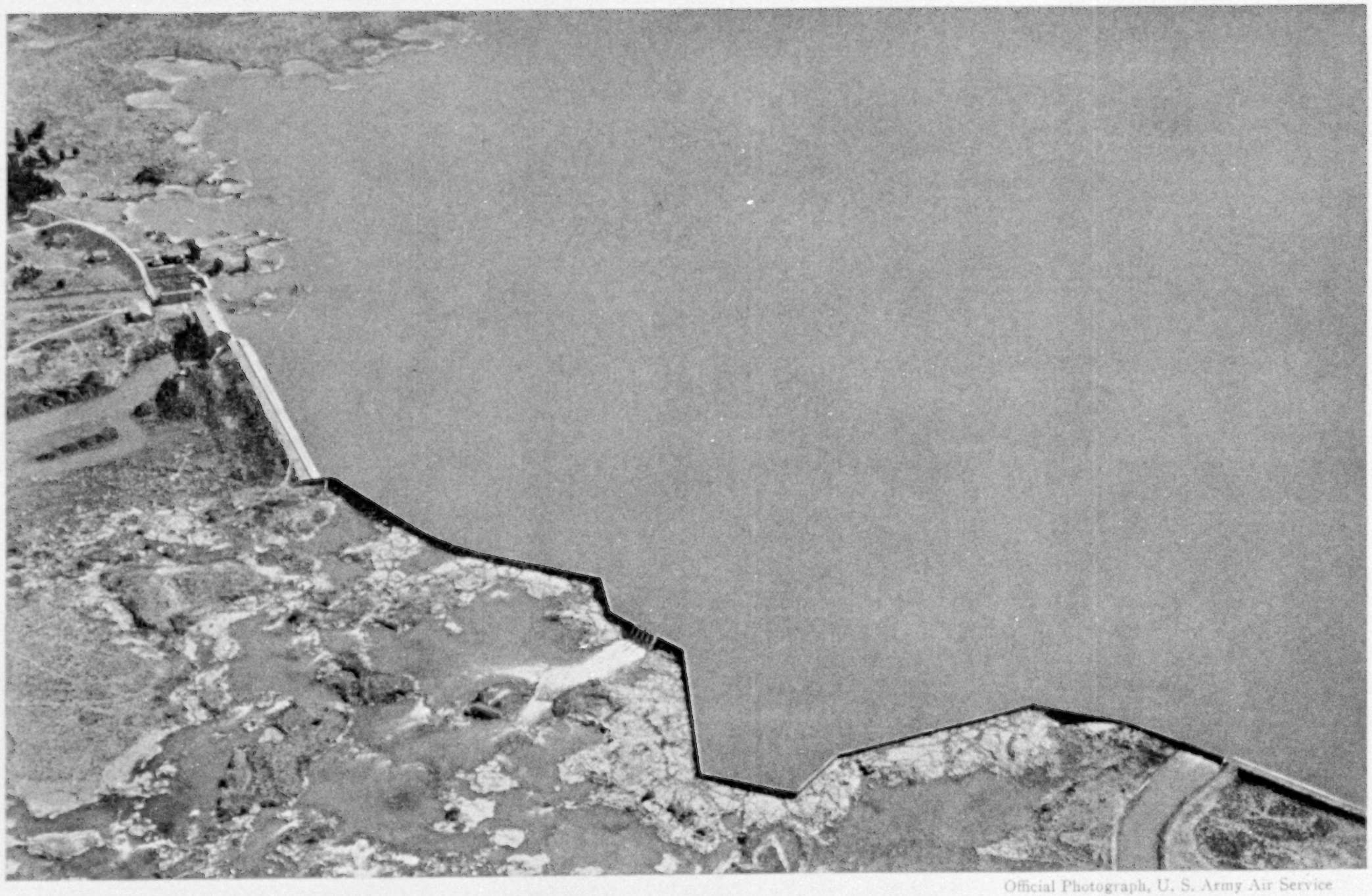
It appeared that the airplane could not gain altitude sufficient to get over the country ahead, yet as each gallon of gasoline was consumed a few more feet of elevation were possible, due to the lightening of the load, and although it remained in flight hardly above the tops of the low hills and buttes, the airplane kept on until the higher elevations near Tecelote, New Mexico, were reached, and was being flown at an altitude of approximately 150 feet above the ground.

Official Photograph, U. S. Army Air Service

THE AIRMAN'S CAMERA SHOWS SQUARES, TRIANGLES, RECTANGLES, AND PARALLELOGRAMS SCATTERED HIGGLEDY-PIGGLEDY OVER THE LANDSCAPE

Down on earth these geometric figures resolve into farms and cultivated fields, reclaimed from the desert through the magic of irrigation at Idaho Falls, Idaho.

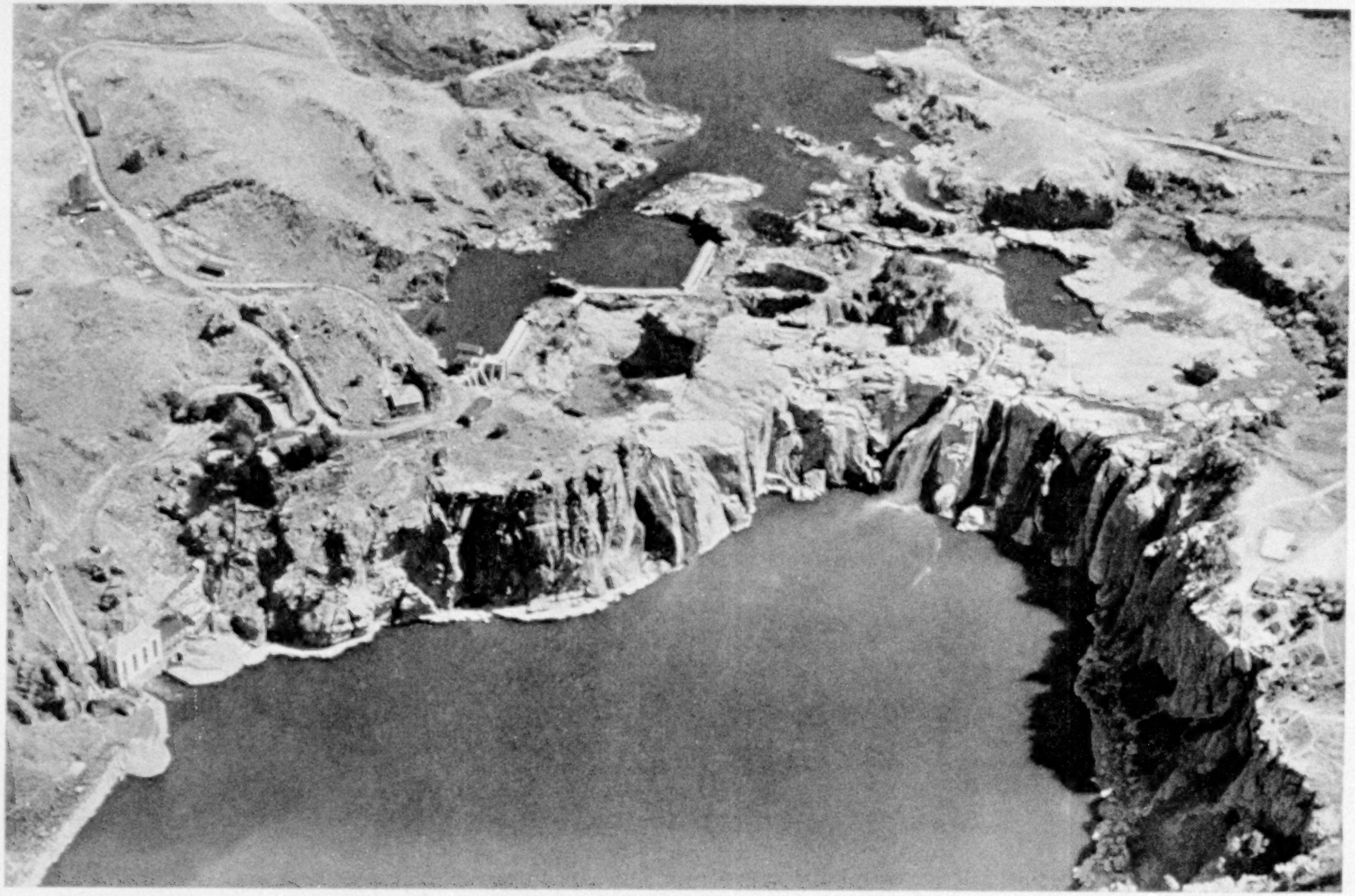
MUSEUM



Official Photograph, U. S. Army Air Service

THE GEOMETRIC WONDERS OF DAM CONSTRUCTION REVEALED BY THE CAMERA OF THE AVIATOR: THE MINIDOKA RESERVOIR, IDAHO

Writing in the NATIONAL GEOGRAPHIC MAGAZINE for June, 1920, the late Franklin K. Lane said of this great irrigation basin: "Seven years ago I visited the Minidoka project and found the people discontented. To-day they are, I suppose, among the happiest farmers and the most contented people in our country. Here I saw a town where there never had been a fire lighted, because at the dam above the town the water had been stored to generate electric power for use as heat, light, and for cooking, as well as to irrigate the land. The women churned with electricity and the sewing-machines were run with electricity. I suppose they had a sort of paddling-machine for the naughty children that they ran by electricity. It was an electric city."



Official Photograph, U. S. Army Air Service

LOOKING DOWN ON SHOSHONE FALLS, IDAHO

Higher than Niagara these falls drop into a pool whose sides are vertical walls of lava worn smooth through countless centuries. An old-fashioned ferry crosses the river above the falls, while below is a modern power house absorbing energy and sending it out over high-tension lines for light and power.

Here the current of air in blowing over the divide probably affected the atmospheric conditions, causing a down current, into which the *T-2* went diving toward the ground at the stalling point, but with terrific ground speed, due to the exceedingly high wind. The airplane missed the cactus and shrubbery by a small margin and was stalled over the surface not more than 20 feet above the ground for a considerable distance, the occupants momentarily expecting a crash. A large mound or foothill was barely missed, besides uneven places of the terrain, before the *T-2* was unsteadily maneuvered to better conditions.

The transport was flown back down the slope for approximately 10 miles in an attempt to gain altitude, while gasoline was being consumed with a resultant lessening of weight.

ONLY THIRTY FEET TO SPARE IN CLEARING A SUMMIT

A second attempt was made in about 20 minutes without success. It was necessary that at least 40 minutes' supply of gasoline be consumed before this high summit could be negotiated. When the required altitude was gained, at a location approximately 10 miles south of the divide, the *T-2* was flown across this high point, grazing the summit with about 30 feet to spare.

While gaining altitude through consumption of gasoline and resultant lessening of load, the sun had gone down. The summit was crossed at dusk. The night closed in very rapidly, and location at this time was extremely difficult, as the moon had not come up and the sky was partially obscured by the clouds. An attempt was made to follow the railroad by flying over it and very close to the ground, but the track was soon lost in the darkness and for a period of at least one half hour our exact position was not known.

If we could reach Tucumcari, New Mexico, the long night's flight could be commenced from a known starting point and over comparatively good country. In a short time the lights of this small town appeared.

Clouds began to form, but no great trouble was yet anticipated from them, although they partially obscured the moon, causing the darkness at times to be very intense and necessitating close flying to the ground in order to observe the dim outline of the railroad.

Here I relieved Lieutenant Kelly in the pilot's seat.

A terrific south wind, causing considerable drift, was blowing directly across the course. Weather conditions became extremely bad. The clouds became lower and lower, and finally were so near the ground that it was necessary occasionally to pass through them or fly very low to keep beneath them. Sometimes the flight was so low that care and watchfulness were required to avoid hitting farmhouses, trees, and buildings in the inky blackness of the night.

There are several isolated families in Oklahoma and Kansas whose slumbers were disturbed in the zero hours of that night by the thunder of a powerful motor within a short distance of their roofs. It must have been an impressive moment for those people, so far from the active life of cities and civilization, to hear the tremendous roar, jump to the window in alarm, and see the huge monoplane, with fire spurting from the exhaust stacks, pass out of view in the storm and blackness, at a speed of 100 miles per hour.

Although we intended to fly directly above the railroad tracks and keep the course in this way, these guide lines were lost in the darkness from time to time, and for considerable periods the pilot would fly entirely by compass, estimating the amount of drift as best he could. Then the strong headlights of a train would appear in the distance and aid in the approximate relocation of the track. Thunderstorms and lightning were on all sides. Rain began falling, not so heavily as to be a great handicap, but annoying, as it made constant wiping of the goggles necessary.

FLYING THROUGH THUNDER, LIGHTNING, AND RAINSTORMS

Our morale was low—very low. I firmly believe that I could easily have crawled under a snake's belly with a high silk hat on, I felt so low. But there was nothing to do but keep going. We could not land. It was pitch black. There would be a flash of lightning and the whole country would be lit up. To

Official Photograph, U. S. Army Air Service

LOOKING DOWN ON TWIN FALLS, SNAKE RIVER, IDAHO

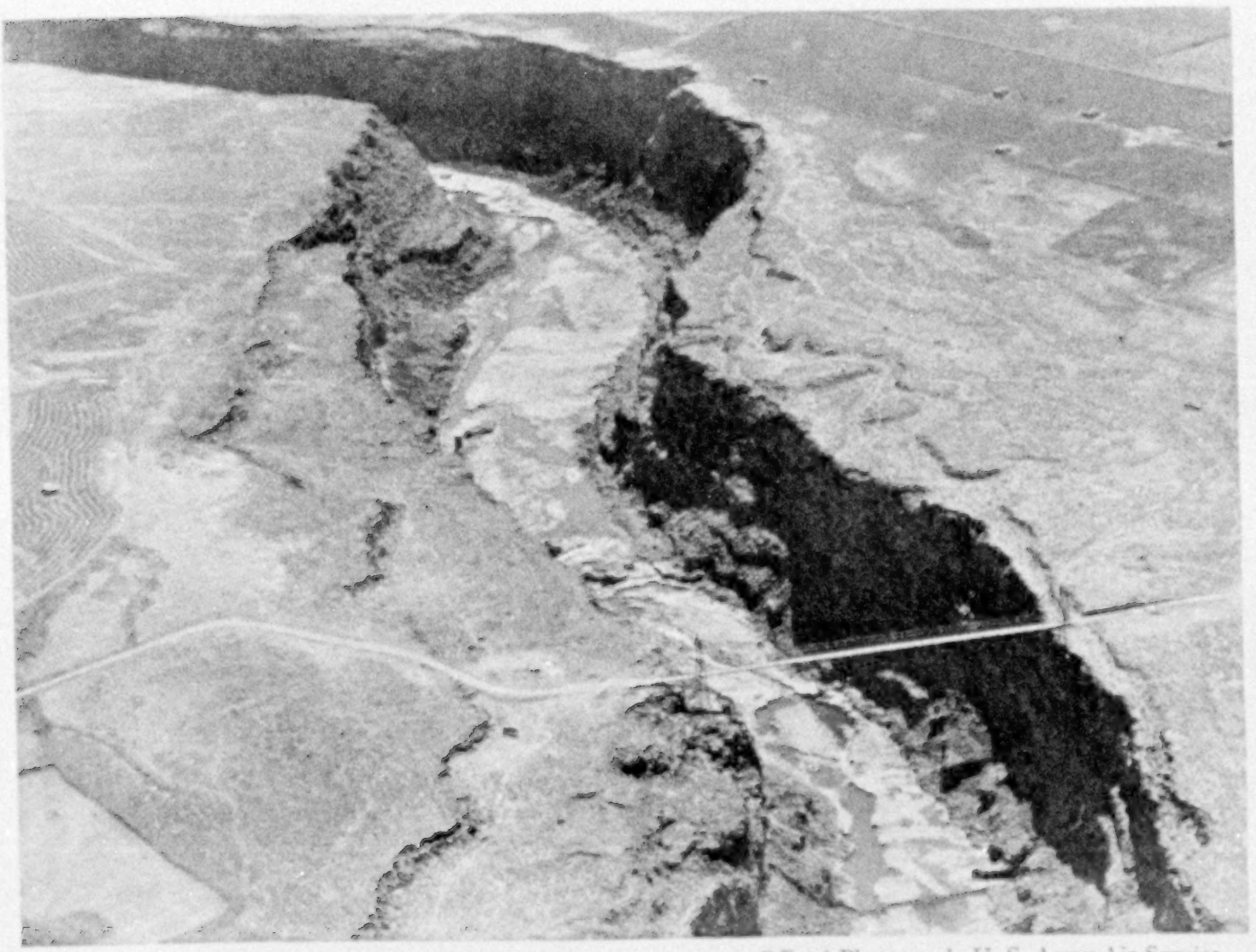
"Here the river divides around a huge outcropping block of lava that resembles nothing so much as the head of a reptile as viewed from above. Snake River, however, gets its name from the many turns and twists that it makes in its course. A few miles below Twin Falls are the Shoshone Falls."—*Stevens and Macready.* (See illustration, page 36.)

our left we would see a cloud-burst and a white sheet of rain falling, straight ahead another deluge or downpour, and then one to the right. Then everything would be jet-black again, as we flew on into the night, expecting momentarily to fly into one of these deluges.

I thought to myself, "Macready, what a fool you are ever to get mixed up in a jack-pot like this." It was certainly no place to be, and we would never have started had we known that we would encounter such bad conditions; but, now that we were actually there, there was nothing to do but keep going. To land in that rough country in the inky blackness meant certain disaster.

It was not the condition that we were actually in which caused anxiety, but the expected conditions. Because of the many storms on all sides, it was anticipated that at almost any moment the *T-2* would plunge into a deluge of water. This did not occur. Considering the extremely bad weather surrounding the path of flight, we were very fortunate not to encounter less favorable situations.

Reference to any newspaper of November 5 will convey the information that the night of November 4-5, during our



Official Photograph, U. S. Army Air Service

A THIN WHITE RIBBON FROM ON HIGH: THE SUSPENSION BRIDGE AT HANSEN, IDAHO

It spans the precipitous black lava walls of the canyon through which flows Snake River.

flight across Oklahoma and Kansas, a severe storm raged and a tornado swept over this area, causing the loss of 12 lives and injury to 80 people. From the standpoint of the weatherman, this tornado was due to a low-pressure area, which apparently was of little importance, but which suddenly sprang into great prominence. The *T-2* missed the tornado, but received the surrounding bad weather.

At Pratt, Kansas, the railroad was intentionally left, and it was necessary to fly a compass course for several hundred miles. The lights of Wichita, Kansas, were seen 10 or 12 miles to the right about 40 minutes after leaving the railroad.

Reliance was placed entirely on the compass from this point onward through the night. Even the groups of lights which had occasionally appeared on the ground to mark the position of small villages, and which afforded a slight means of checking the course, had now disappeared.

The people of Kansas and Oklahoma apparently retire early. There were no cottage lights after 10 or 11 o'clock, and there were no large towns along the path of flight. For long stretches of 30 or 40 minutes, no lights of any description would appear. Occasionally the clouds would open up, when the section lines of the fields and roads could be dimly discerned on the ground.

These section lines were invaluable aids, affording a means of checking the compass along the lines running east and west. There was a cross wind approaching the proportions of a gale, causing considerable drift. The *T-2* would be flown, or "crabbed," along an east-and-west line and the approximate amount of drift estimated by reading the compass when the plane was actually traveling in a due-east direction.

The maps were laid off according to

Official Photograph, U. S. Army Air Service

NOT SO GOOD FOR THE AVIATOR IF THE MOTOR FAILS

From Arrow Rock Dam, Idaho, rolling hills covered with sagebrush extend to the south, near Boise. After traversing this sort of country, one is prepared to give full credence to the story that a pioneer, upon seeing green trees lining the banks of the Boise River, cried "Les Bois!" (the woods), and so gave a name to the future city on the site of their exclamation.

scale, in ten-mile distances, along the route as planned, and the time was constantly being checked between known points on the ground. Although long stretches were flown without lights appearing, the compass course, with the drift allowed for, was estimated, so that it came approximately along the intended points, and these points could be checked on the map by the lights.

LOCATION CHECKED BY ST. LOUIS LIGHTS

The time of approach and probable position of a town of sufficient size to have some street lights would be estimated, and this object looked for when, according to the map, we were nearing it. Its position would not always be found where expected, but would be close enough, so that by using average judgment the group of lights could be designated as the town indicated on the map.

The general line of flight was toward a point on the Missouri River above its junction with the Mississippi. It was expected that the Missouri could be picked up during the night at a point north of St. Louis. If doubt existed regarding location, it could be followed in a general direction to check the course at St. Louis. It happened, however, that the Missouri River was reached at the indicated point. When the lights of St. Louis later appeared, they could be definitely recognized.

The pilots changed at the Missouri, Lieutenant Kelly taking the controls.

A flight of this kind is a severe test of an individual's disposition. Although many times, in the excitement, hardship, and worry, there was the greatest cause for irritation and anger, both pilots worked together harmoniously, even when their nervous systems were strained to the limit, during this stormy night.

It was still dark when the lights of St. Louis were passed, the first signs of daybreak showing in the east shortly after. It was a very welcome sight to the occupants of the airplane as the outline of the horizon began to appear, and when daybreak approached it was the thought of both that practically all troubles of the long trip were over.

The tremendous original weight of the airplane was gone, flying was comparatively easy, the storms had been passed through, the black night was over, and the pilots were in a country well known to both and over which they had flown many times. Twelve and one-half hours had been spent in darkness.

The *T-2* had passed through parts of six States during darkness—New Mexico, Texas, Oklahoma, Kansas, Missouri, and Illinois.

That dim light in the horizon certainly looked good, and I sent up a note to Kelly. "Nice work, Kelly, old boy. What do you want for supper to-night at the Waldorf-Astoria?"

A short distance beyond Terre Haute, Kelly sent back a note to the effect that a forced landing seemed probable, because of the rapidly decreasing water supply, due to cracked cylinder jackets on the engine. "Mac, another cylinder has burst. Lucky if we get to Dayton," he said.

Pilots were changed at this point. I immediately observed, when taking the front control seat, that conditions were extremely bad. The water was shooting from both sides of the engine in small streams. The first cracked cylinder had been observed about 400 miles out from San Diego. It was not deemed of great importance at that time, although it was watched very closely.

The loss of water from one cracked cylinder was not sufficient to have brought the ship to the ground before reaching New York; but the other cylinders, which had gone in combination with this original one, caused a loss of water so great that it was almost immediately seen that a forced landing would be necessary.

FEEDING THE ENGINE SOUP AND COFFEE

About 50 miles from Indianapolis the temperature began to rise very rapidly and I turned back on the course to a field which had previously been observed, with the intention of landing. It did not seem possible to continue. Kelly, however, who was in the rear, poured the drinking water, coffee, consommé, and all other liquids into the radiator, and with these additions the airplane was flown to the Indianapolis Speedway, where we landed.

A short time after landing we bought a newspaper. "Transcontinental flyers make flight on soup," was the headline. The rest of the flight particulars were

XUM

Official Photograph, U. S. Army Air Service

ARROW ROCK DAM, ONE OF THE HIGHEST IN THE WORLD, EAST OF BOISE, IDAHO

The normal flow of the river below this site is regulated by the streams shooting from the face of the dam. At the time that this photograph was made the summer needs had reduced the water in the reservoir, foot by foot. In the late spring melting snows on the mountains fill the reservoir again. At the near end of the dam is an emergency spillway, used to deflect water to an adjoining canyon when there is danger of its spilling over the center.

secondary. I imagine that even now the majority of people who remember the event remember it entirely from the soup standpoint.

On arriving at the speedway it was estimated that the flight could be continued to Fort Benjamin Harrison, a military post, where far greater repair facilities could be obtained.

But while flying over Indianapolis to the post the engine again began to heat very rapidly, a temperature of 110° being reached. It became necessary to throttle down, with the result that the airplane was partly flown and partly glided to the Fort. A turn was made around the field to get the proper position to glide for a landing. As we reached the edge of the field, the throttle was pulled back. The propeller stopped, frozen tight by the heat of the engine!

A good landing was made in the center of the field, and the pilots immediately jumped from the plane in order to avoid the danger of fire, which seemed probable, as a dense cloud of white smoke was pouring from the engine. An automobile rushed out with fire-extinguishers.

Official Photograph, U. S. Army Air Service

LOOKING UP THE BOISE RIVER FROM ARROW ROCK DAM

The reservoir winds back through the hills for miles beyond the dam, which was completed in five years. It is surrounded by rolling hills, and no flat areas are available for emergency landing in the event of engine trouble. Aviators must depend on parachutes unless they are near enough to the reservoir to drop the plane into it.

The Commanding Officer of McCook Field was immediately notified by telephone, and the respects of the two pilots were paid to the Commanding General of the Fifth Corps Area.

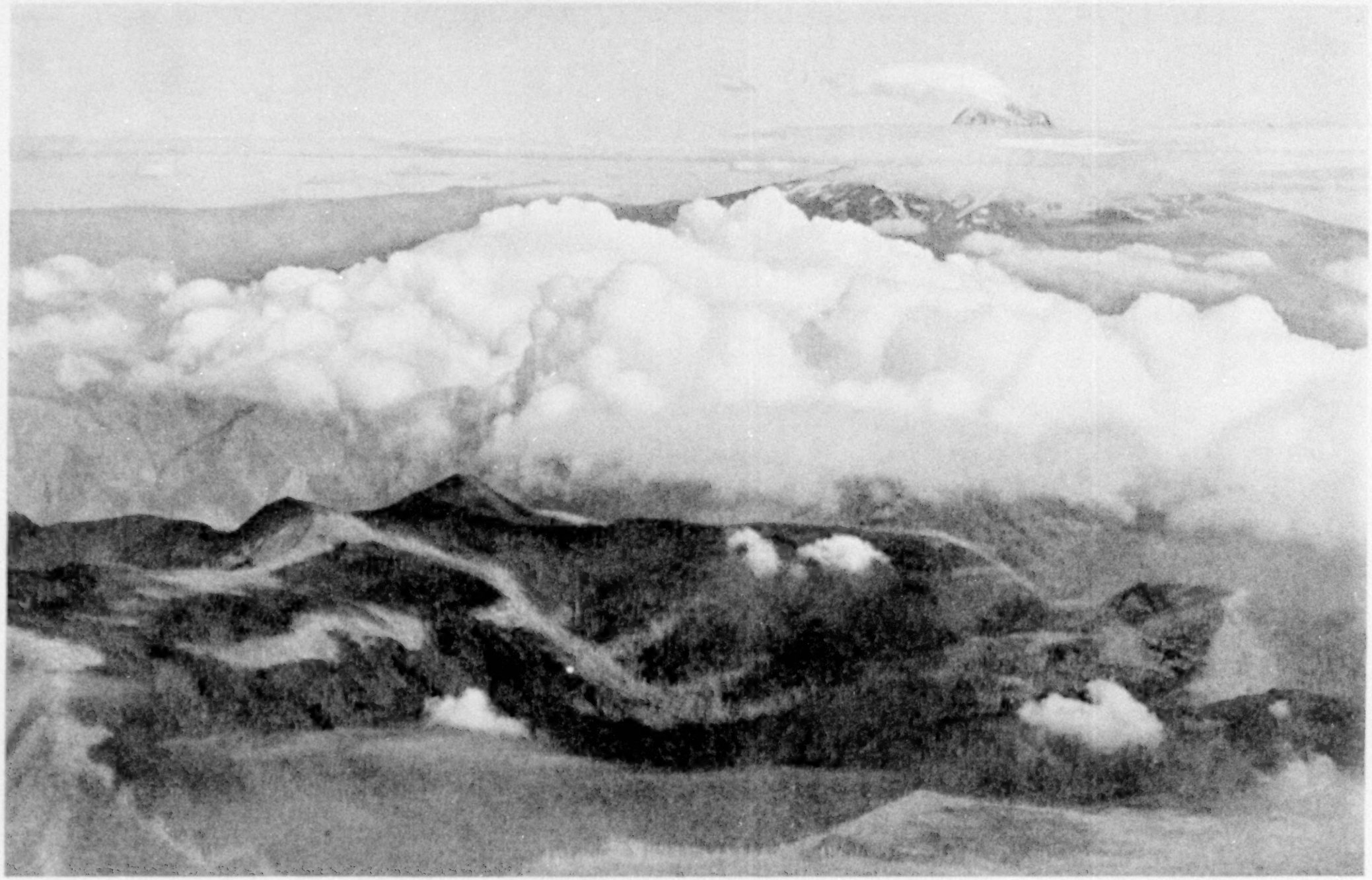
Before leaving in another airplane for McCook Field, Dayton, both Kelly and I requested telegraph blanks and sent wires to our parents, telling them of our safe landing. I wired my mother as follows:

"Mrs. B. Macready,
614 So. Carondelet St.,
Los Angeles, Cal.:

"Landed safely; broke engine; pilots uninjured."

and later observed in the Associated Press notices that "the first thing that Macready did on landing was to send a wire to his wife." Inasmuch as I had no wife at that time, I have been explaining ever since about this wife hidden in California, whom none of my friends had ever heard of, and the explanations did not appear satisfactory. I attempted to clear the situation by getting married on the completion of the second flight, but now many people believe that I am a bigamist.

Although naturally very tired toward the finish of the flight, neither of us was in bad shape, but the physical and mental



Official Photograph, U. S. Army Air Service

AN AIRPLANE VIEW OF THREE KINDS OF CLOUDS HOVERING ABOUT MOUNT ADAMS, WASHINGTON

In the foreground is the familiar, businesslike rain cloud (cumulo-nimbus); in the middle distance is a stringy, wisplike elevated fog, and above this is a frozen cloud (cirrus), daintiest and most beautiful of the cloud clan.

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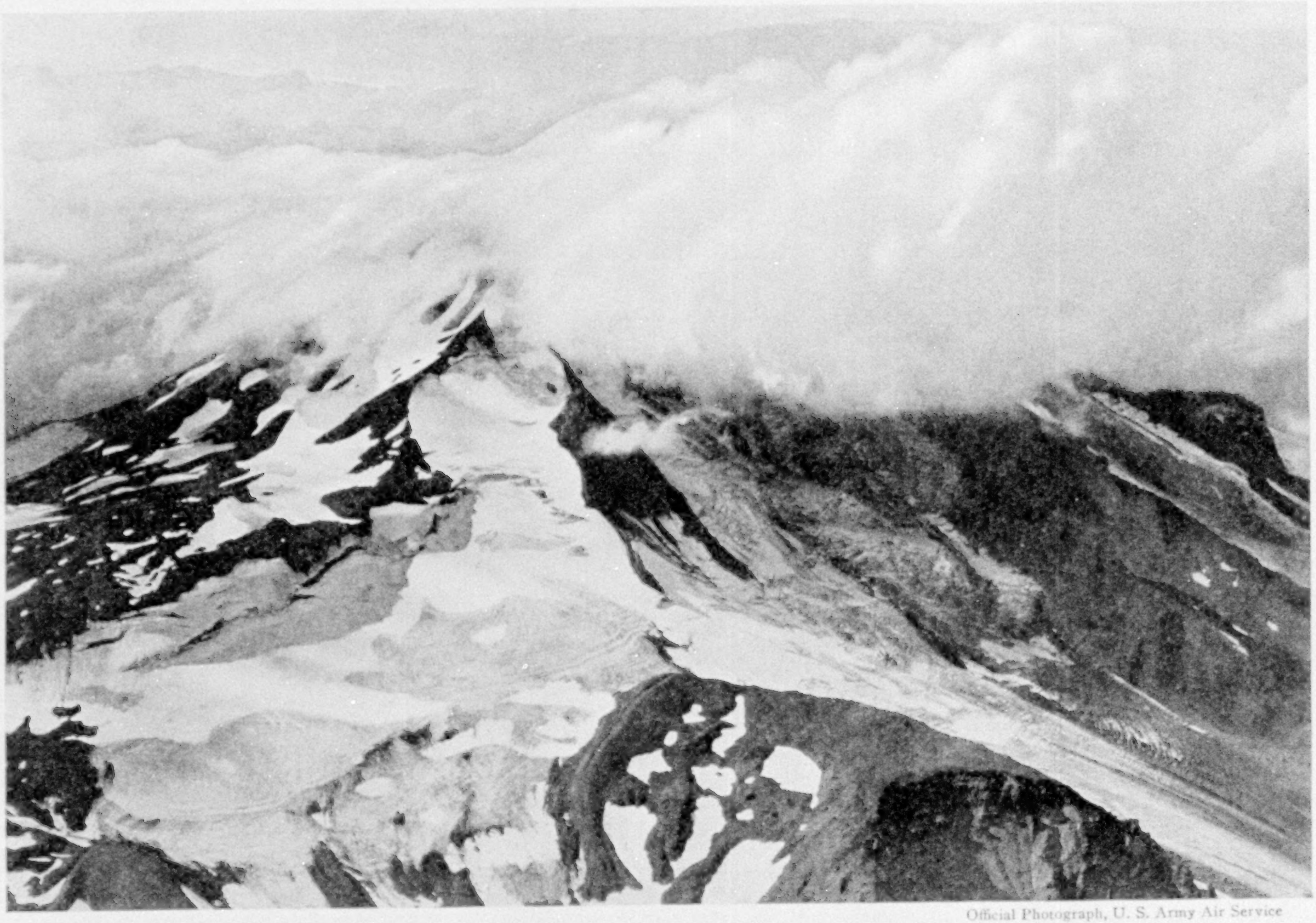


Official Photograph, U. S. Army Air Service

THE AIRMAN PRESENTS A CHAPTER IN THE ROMANCE OF GEOLOGY

In the foreground are glaciers, which through the ages have irresistibly carved out valleys and canyons. Their terminal moraines are clearly defined. Caressing the summit of Mount Adams (Washington) are the clouds, which are water-bearers of Nature's colossal irrigation scheme.

Official Photograph, U. S. Army Air Service

CRUISING ABOVE THE CLOUDS

To the airman, clouds are as dangerous as shoals and reefs to the mariner. Not only do they conceal mountains, but, when flying above them, the aviator has no markers to establish his direction; he cannot even be sure he is not flying upside down. Recent tests of new instruments promise to free the aviator from this handicap and enable him to follow a course by "dead reckoning."

strain had been far greater than in the endurance flight. The question of physical fatigue was the only factor to be considered in the endurance flight—flying 35 hours without rest or sleep. There was no danger to be considered, and the mind was relaxed and at ease.

The non-stop flight was filled with continual danger and uncertainty. The brain was constantly wide awake and alert, and there was considerable nervous strain and anxiety, which in itself was very tiring, combined with the actual muscular exertion of handling the big plane.

PLANNING FOR A THIRD ATTEMPT

When Kelly and I stepped out of the *T-2* in Indianapolis we did not do much talking about transcontinental non-stop flights. We were through. Any man who was foolish enough to want our job was welcome to it. Never, never again for us! Neither one said much, but we did a lot of thinking, and decided in our own minds that transcontinental non-stop flights were good things to keep away from. We were entirely willing for some one else to take our place. We wanted to forget it.

We flew over to Dayton and obtained a couple of days' rest. Then, without any warning, Kelly put the map of the United States up on the wall, and before we knew it we were planning a new route across the continent.

The experience of the first trip convinced us that the proper direction, if the big obstacle of the prevailing head wind could be overcome, was from east to west. As previously stated, our reason for originally starting from the Pacific coast was the fact that there was a prevailing wind from west to east of 22 miles per hour, although the distance in traveling from the west was very much longer, due to the existence of high mountains along the Pacific coast and because it was necessary to follow the low parts of the continent in choosing the route. After arrival in San Diego it was found that this helping wind, when it existed, would invariably blow into an area of bad weather.

On our first attempts the high elevations occurred when the plane still retained its extremely heavy load of gasoline, making it necessary to retrace our course twice, and in one case lose 45 minutes hovering about, waiting for gasoline to be consumed, with the resultant lessening of weight before the plane could cross a high elevation in New Mexico.

Appreciating these facts after landing at Indianapolis, we again talked with the weather forecaster in Washington and learned that during the last two weeks of April of each year there is a peculiar weather condition, called a Hudson Bay High, which reverses the wind direction across the continent and instead of blowing from west to east, it then blows from east to west. This condition is caused by a very large high-pressure area occurring and spreading over the vicinity of Hudson Bay. One, two, or possibly three occur each year (see map, page 4).

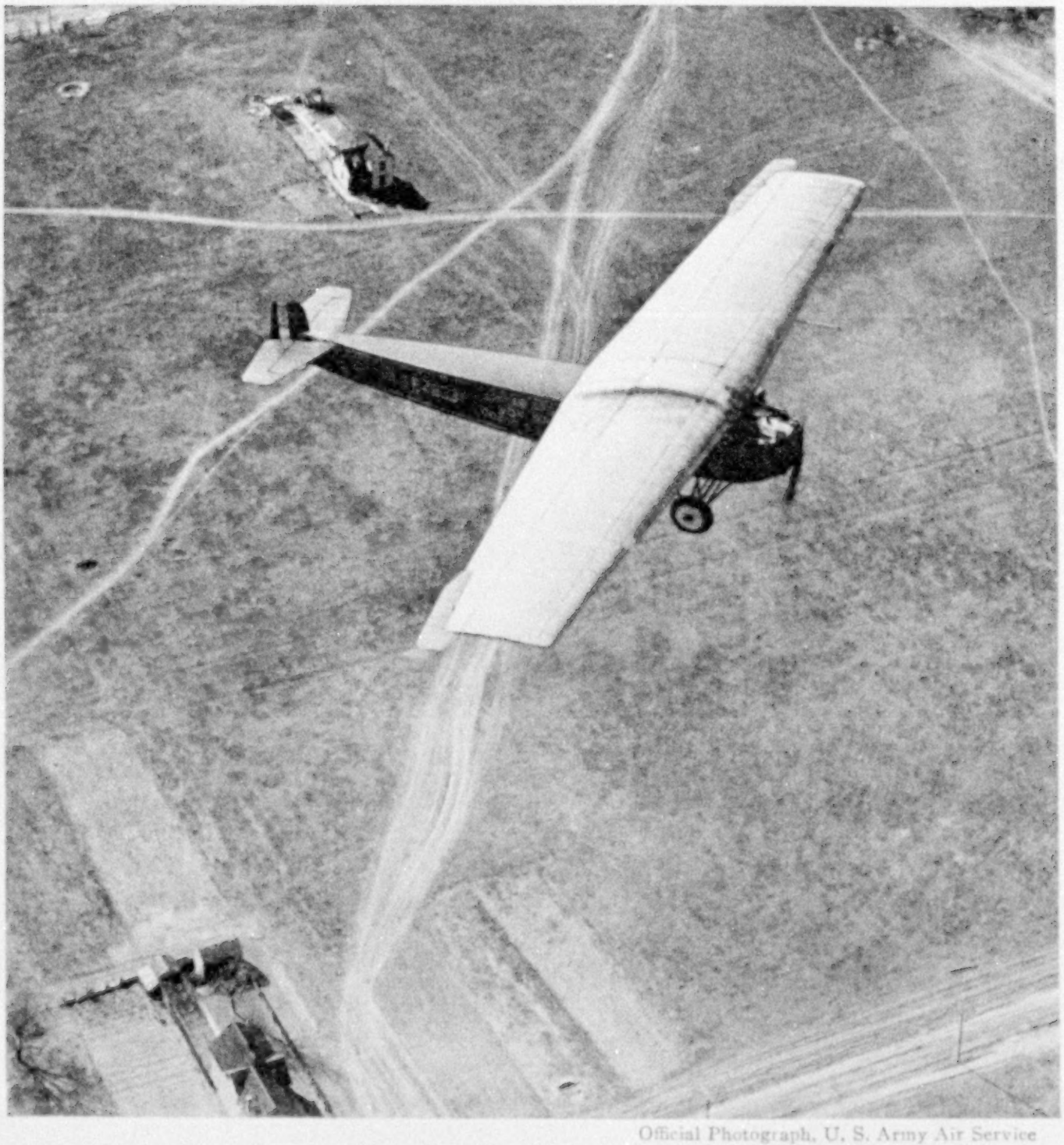
THE WORLD'S DURATION RECORD OFFICIALLY SMASHED

As our duration record at San Diego (see pages 17 to 25) had not been accepted by the International Association, and two Frenchmen had captured the world's duration record by remaining in the air for thirty-four hours, in order to regain this record for the Army Air Service, it was decided to repeat our endurance flight at Dayton during the winter. Winter is no time to make airplane duration flights, and Dayton days and nights are not the mild, clear ones of San Diego.

We made three attempts during the winter. On the first attempt the mayor and influential citizens of Dayton were out to bid us Godspeed, the movies took pictures, we were slapped on the back, and many goodbyes were said, as we climbed into the ship, to be gone for two days. We waved to the multitude, "gave her the gun," rolled about 50 feet, and stuck tight in the mud up to the hubs. It was an anticlimax and made Kelly and me feel foolish.

On the second attempt we got off the ground with an experimental high compression engine and remained in the air, with a temperature of eight degrees above zero, in very bad weather, for approximately eight hours, landing at 12:30 a. m., in a snowstorm, with a practically dead engine and 10,000 pounds of weight.

XUM



Official Photograph, U. S. Army Air Service

A SIDELONG GLANCE FROM ABOVE AT THE "T-2" ON ITS TRANSCONTINENTAL FLIGHT

Having performed its notable feat, the big craft now rests in the Aircraft Building of the Smithsonian Institution in Washington. Its wing-spread is 74 feet 10 inches; its length, 49 feet; and its height, 11 feet. The power-plant is a 400 H. P. Liberty engine. The old map of the United States showing the route followed by Macready and Kelly is still pasted in the fuselage.

We were fortunate in not seriously injuring the plane during this forced landing in total darkness, the only damage being a bent spreader between the wheels of the landing gear.

We were flying a measured course, which took us about 20 miles out in the open country from Dayton. Kelly had flown the first six hours. It was during the second shift that excessive preignition developed in the engine. We had made our original endurance flight at San Diego because we had been doubtful of landing the *T-2* in daylight with the heavy load, even with the help of the engine, for fear of crashing the plane; and now, in total darkness, in a snowstorm, with no searchlights or landing lights of any description and approximately the same load, the engine began to die.

Imagine yourself up in the air in a black night, without knowing what is below, and then have the engine quit!

We knew the approximate position of

Official Photograph, U. S. Army Air Service

THE DALLES, COLUMBIA RIVER, OREGON

Dalles is derived from a French term for rapids where the rocky river bed wears away in smooth slabs. It is applied especially to rapids produced by the narrowing of rivers between basaltic rocks, and was given to this part of the Columbia River by Canadian voyageurs in the Hudson's Bay Service. Other famous dalles are those of the Wisconsin, the St. Louis, and St. Croix rivers.

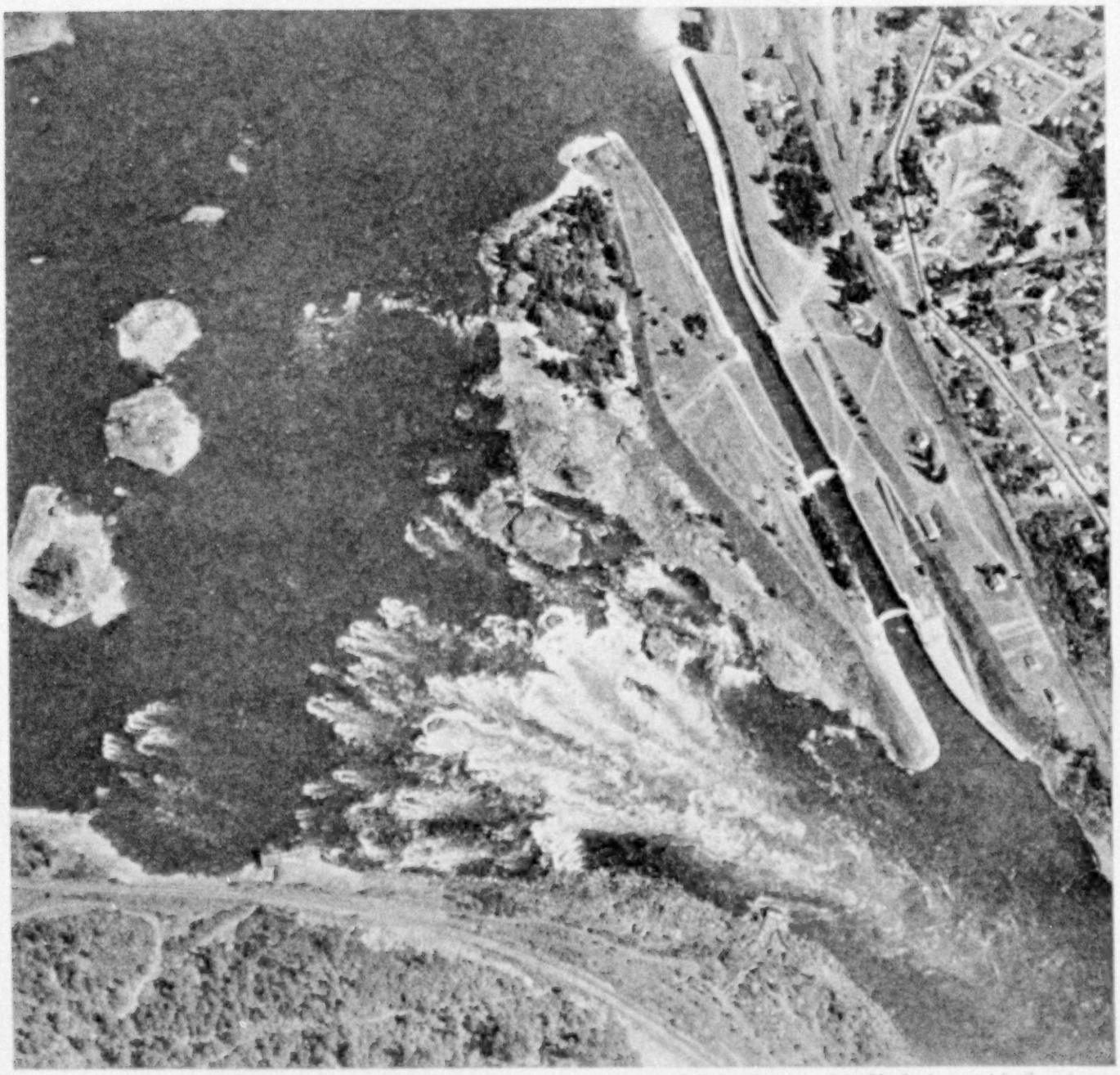
the open field, so we pointed the nose of the plane for a light on top of a building, shot over this light, whose height above the ground we guessed, and glided for a seemingly interminable period of time out into the blackness.

We could not see the ground, but went through the mechanical motions of landing, and then waited for what was to come, not knowing how high we were above the earth. We were not far up and the bump was not great. We were lucky.

A standard compression engine was put in the *T-2*, and on April 17 and 18, 1923, during the dark of the moon, we stayed in the air at Dayton 36 hours and 5 minutes, landing at 10 o'clock of the second night by the aid of a searchlight. This broke the world's duration record.

ORVILLE WRIGHT WITNESS OF BIG EVENT

Orville Wright, the inventor of the airplane and the man who made the first successful flight in a motor-driven machine, acted as an official observer. The flight took place from the same ground on which he and his brother had done their first experimenting and made flights



Official Photograph, U. S. Army Air Service

THE CASCADE LOCKS OF THE COLUMBIA RIVER

"We have seen many great rivers from the air—the Rhine, the Hudson, and the St. Lawrence, among others—but none can excel the beauty of the Columbia from The Dalles to Portland."—*Stevens.*

of a few seconds' or minutes' duration. What a satisfaction it must have been to this man to stand on the same spot, only 19 years later, and see a huge airplane, with 10,850 pounds of weight, remain in the air continuously, through night and day, for more than 36 hours!

Flying by moonlight is hardly more difficult than flying in daylight, but flying in total darkness is very undesirable. The reason for making this endurance flight during the dark of the moon was that we wished to be in New York to start on the transcontinental flight during the latter part of April, in order to take advantage of the peculiar Hudson Bay High weather conditions which exist only at this time of year (see page 47). It would have been much nicer to have waited for the moonlight, but we were pressed for time and the high-pressure conditions which we wanted would be slipping by.

There was nothing but inky blackness below, with the occasional flicker of auto lights on the road, farmhouses, and cities. Nothing was distinguishable. It was impossible to tell what was beneath, whether level fields, forests, buildings, rivers, or foothills. We had 14 hours of total darkness. It was agreed that should our engine quit we would throw out the lighting flare, and if it did not function or

Official Photograph, U. S. Army Air Service

MOUNT HOOD AND THE CLOUD WHICH GIVES IT THAT NAME (SEE ALSO PAGE 90)

"We change our course and climb at an angle that will put us above the summit of Mount Hood, whose elevation is 11,253 feet. As we get higher, the wind gets stronger from the west, and our ground speed is comparatively slow as we round the peak on the north. We make a number of exposures and try to photograph particularly the banner cloud that floats from the peak. It is this cloud which gives Mount Hood its name; seen from the west, the cloud appears as a delicate lacelike structure, dome-shaped, hovering exactly over and quite close to the peak, like a hood. From the north it appears as a great white flag floating from the lofty pinnacle."—*Stevens and Macready.*

there was no landing space below, that we would jump out in our parachutes. The Liberty engine functioned perfectly.

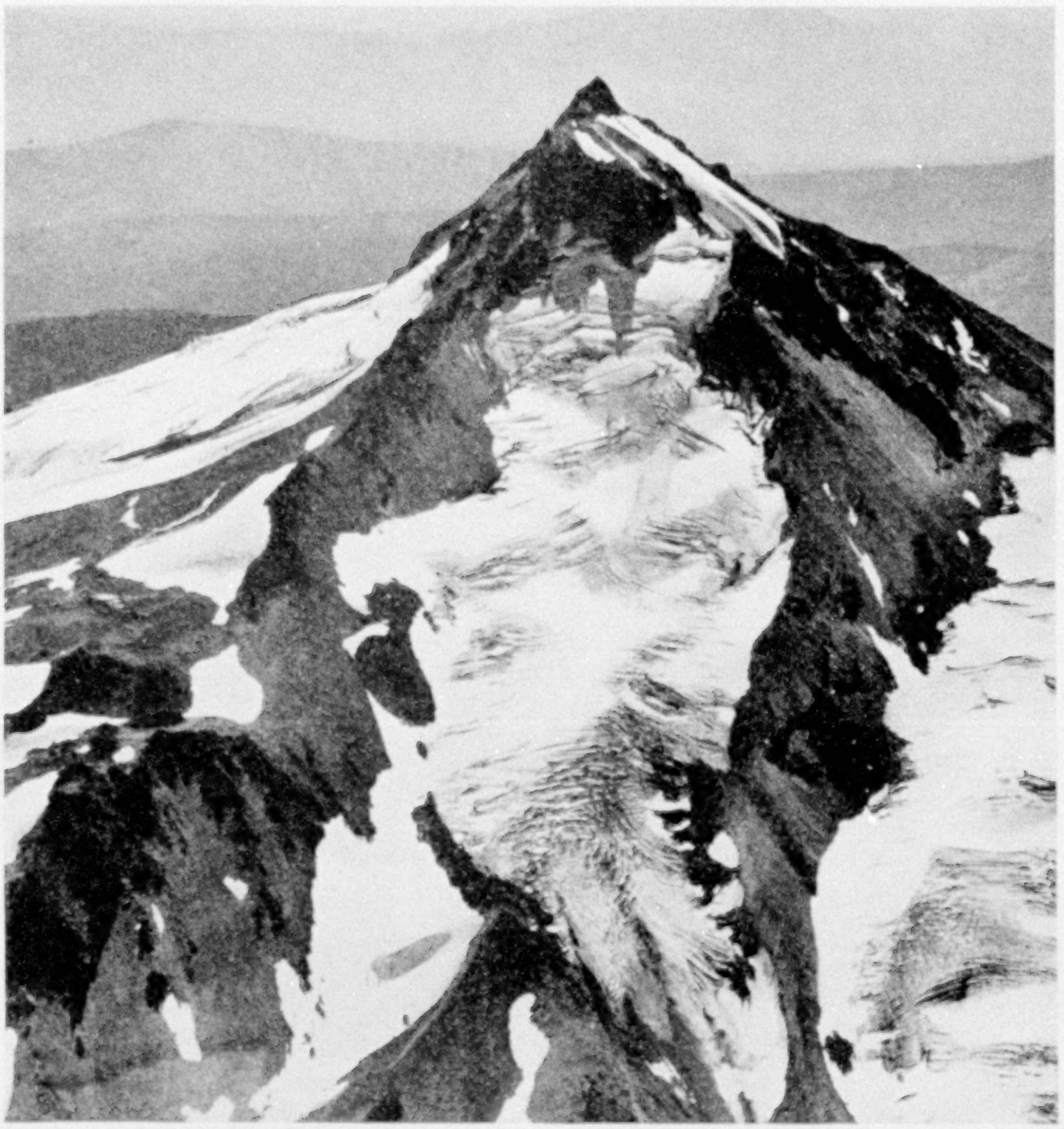
On landing at night we immediately took steps to have the engine changed and the plane made ready for the trip to New York.

Kelly, the mechanics, and I worked during the ensuing few nights as well as the days and on Sunday, in order to get the engine quickly installed. Complete installation was not effected until noon of the day of starting. It was necessary to fly to Washington, as we could not have reached New York by nightfall of that day.

We saw the chief forecaster in Washington and put in our order for weather. He gave us little encouragement. A Hudson Bay High had already occurred and the second was then in existence. It did not seem possible that still another period of favorable weather conditions would occur.

The engine and plane were flight-tested during our flights to Washington and New York. Minor difficulties cropped out during the trip to Washington, and still more slight mechanical troubles occurred while flying to New York. After landing at Mitchel Field, Long Island, it was necessary to spend approximately two days in working on the engine, correcting these "bugs," and insuring the proper functioning of every mechanical detail for our contemplated long flight.

Kelly and I were busy with the plane during this time. After we were assured



Official Photograph, U. S. Army Air Service

THE AIRMAN SKIMS ALONG THE KNIFELIKE RIDGE OF MOUNT JEFFERSON, OREGON, AND OBTAINS THIS VIEW

that the *T-2* was as nearly mechanically perfect as possible we went to the Weather Bureau in New York and explained to the weather people our problem.

WATCHING THE WEATHER BUREAU MAP

Weather reports were received in New York by telegraph at 10:30 or 11 p. m. and about 10:30 a. m., reports coming from all over the United States. For the next two days we practically lived at the Weather Bureau, studying these reports. The country was all shot to pieces with low-pressure areas in the west and central sections of the United States.

About two days before the start, there was a very small and insignificant high-pressure area which appeared on the map in Canada. Although this was apparently unimportant, we watched it with considerable interest. Little is known of weather conditions near Hudson Bay, as there is but one station in that vicinity. The weather officials, although courteous, gave us no encouragement; they

Official Photograph, U. S. Army Air Service

SNOW BEAUTIFIES MANY OF THE SCARS SEARED BY VOLCANIC FIRES ON THE SLOPES OF LOVELY MOUNT SHASTA

"Before us is the enormous bulk of Mount Shasta, towering 14,380 feet in the air. Its snow-clad sides have been visible for an hour. On the west slope, some distance below the summit, is a gigantic extinct crater, lined with snow. This is one of the southernmost peaks of the Cascade Range and is exceeded in the United States in height, by a few score feet only, by Mount Rainier and by Mount Whitney, in the Sierra Nevada."—*Stevens and Macready.*

seemed to think that the chances were greatly against the development of a Hudson Bay High.

The morning before we left on the flight, this high-pressure area was greater and a storm or low-pressure area, which had been drifting toward the northeast, appeared to change its course slightly to a more easterly direction. From these indications it seemed that there was a chance of the high-pressure condition spreading out and forcing the storm area to the south (see map, page 4).

Hoping for the best development from these indications, we returned to Mitchel Field and made final preparations for the flight next day, although even then it was a fifty-fifty chance that a Hudson Bay High would not develop and we would not start. It was possible to make the entire distance across the continent in still air, but a prevailing head wind would not permit us to reach San Diego.

It was our intention to return to the Weather Bureau in New York that night, see the final map, and, if satisfactory,

Official Photograph, U. S. Army Air Service

LOOKING DOWN UPON THE ONLY ACTIVE VOLCANO IN THE FORTY-EIGHT STATES

This view of the summit of Mount Lassen, California, shows the new crater, to the left; the old crater, in the center, and a high spur of the mountain, in the upper right corner. In the distance is the ridge with the winding trail which forms the only approach to the craters. "In 1914 this mountain kicked up quite a fuss, opening up a new crater on the north side, blowing out large quantities of mud and rocks, and filling the creeks on the north with streams of semiliquid material. Since then it has been comparatively quiet, blowing out steam and gas, and a few rocks, at irregular intervals."—*Stevens and Macready.*

return to Mitchel Field after midnight. Major Weaver, the commanding officer at the field, sent a soldier to New York to bring back a carbon copy of the map, and thus permitted us to get some sleep, which we greatly needed, as we had very little rest during the few preceding days. We were dog-tired.

At 11 o'clock we telephoned. Conditions seemed to be developing as we wished, although there still was doubt.

At 4 o'clock the next morning we flew the *T-2* from Mitchel Field to Roosevelt Field, as the former was much too small for a take-off with the heavy load.

"WE TAKE A CHANCE"

At 10:30 in the morning we again telephoned the Weather Bureau in New York. The conditions appeared very good from the standpoint of wind direction. We then made our final decision to leave. About 11 o'clock a telegram was received from the Weather Bureau

Official Photograph, U. S. Army Air Service

AFTER THE GOLD-DIGGERS HAVE GONE THEIR WAY

"On passing Marysville, California, a circle was made to photograph on the Yuba River, the extraordinary appearance of ground that has been dug from 60 to 70 feet deep to bedrock and then stacked in symmetrical rows by a gold dredge."—*Stevens and Macready.* The abandoned dredge is to be seen above the town near the upper left corner.

at Washington, worded something like this:

> New York to Dayton, Ohio, northeast and east winds, clear sky; Dayton, Ohio, to Kansas-Missouri line, low clouds and rain, east winds; Kansas-Missouri line to San Diego, clear sky, variable winds.

We hesitated. We did not like the idea of the low clouds and rain at night over the northern Ozark Mountains. These were the elements that we wished to avoid. Otherwise the forecast was exceptionally good. This was our last opportunity and we decided to take a chance. It was the period of the full moon and we would have moonlight during the early morning hours.

After the flight some one asked Kelly if we encountered favorable winds. Kelly answered: "We did not encounter favorable winds; we picked them," which was in reality the case.

We had lunch at Mitchel Field, at the quarters of Major and Mrs. Weaver, and after lunch left for Roosevelt Field, where the plane was in position for the take-off. Kelly, as was our custom, was to take the plane off. I was to land at San Diego.

"FLOPPING" OVER HANGARS ON THE TAKE-OFF

The first attempt at a take-off was a failure. After rolling at top speed for almost a mile, over the ground, the huge, heavy transport displayed no sign of rising into the air, and had we continued we would have crashed into the wires and trees ahead. The airplane was loaded with ten thousand eight hundred fifty pounds of total load.

The *T-2* was taxied to another position on the field and a second attempt was

made. Roosevelt Field is a plateau about one mile square. Hazelhurst Field is the same size, adjacent, and about 20 feet below. There is a row of aërial mail hangars on the far side of Hazelhurst Field. The nose of our airplane was pointed toward those hangars, over two miles distant, and, again waving goodbye to the small group of anxious spectators, we started, lumbering heavily across the ground, gathering speed and momentum as we went.

The big monoplane bounced and bounced but did not rise. It was still on the ground when we came to the 20-foot drop-off from Roosevelt to Hazelhurst Field. I was sitting behind, watching the ground go by and the hangars getting nearer.

When we came to the drop-off I wondered whether we would go over the ledge and settle down to the ground. Over we went and settled down, but not quite to the earth. The *T-2* was flying but without any apparent climb, and the big hangars were straight ahead.

I don't know yet whether we went over the hangars. We expected to hit them, but I guess we did not. People at the take-off say that we flopped over them, and then went down out of sight on the other side. They started to run after us to pick up the pieces.

A STRANGER'S FAITH AND A $5,000 WAGER

Colonel Franklin R. Kenny, a stranger to us, happened to be there with a friend. The friend said, "What fools those boys are! They'll never make it." "I'll bet you $5,000 even money they will," said Colonel Kenny.

The heavily loaded plane could hardly maintain itself in level flight. For 20 minutes over Long Island our climb was hardly appreciable. In fact, for the first few miles we barely cleared the poles and wires.

It appeared to me, riding behind, that we would hit the open fields, would settle down into them, due to the heat radiation and warmer air coming from the ground, and would barely clear the surrounding obstructions.

Conversation within the plane was, of course, impossible, because of the noise of the engine. We could not talk things over until after we landed. At San Diego, however, I said to the wild Irishman, "Kelly, did you get much of a kick when we were settling down into those small open fields on Long Island?" "Not a great deal," he replied, "I was nosing her down a bit to get some more speed to pull us over those telephone poles."

It certainly felt like settling down to me, but at any rate Kelly did a magnificent piece of work in taking the huge, heavy plane off the way that he did. He handled a delicate situation in a masterly manner.

We were 300 or 400 feet over Coney Island. Our altitude when crossing New Jersey was about the same. More altitude was gained during our flight across Pennsylvania.

Pennsylvania is a very difficult State to fly over, as there are no straight lines from which to judge directions on the ground and the atmosphere is invariably misty and smoky. The rivers, automobile roads, and railroads wind in all directions and the cities are covered with smoke and hidden in the hills. The boundaries of farms and fields run diagonally in various directions and are rarely straight.

In the Far West, even in the sections where one may fly for 100 miles without sign of life, there may be places where some poor homesteader has many years before attempted to make a living from the soil and has laid out a part of his homestead. His lines run north and south and east and west, following the legal subdivisions. He could not make a go of it, perhaps, and was starved out, but before doing so he left a good straight line on the ground that an aviator may use in checking his compass. No matter what the compass reading of the plane may be, the pilot can always fly along one of these lines and get his general direction. In Pennsylvania there is no regularity to the fields, roads, or markings on the ground.

MAKING A DELICATE ADJUSTMENT IN THE AIR

The little things are sometimes the most important and can cause the greatest amount of trouble. About a half hour after leaving Long Island, Kelly shook the wheel for me to take the controls.

It is difficult to fly from behind. There is no visibility straight ahead or to the

Official Photograph, U. S. Army Air Service

VIEWED FROM AN AIRPLANE, YOSEMITE FALLS DWINDLE TO A SPARKLING RIBBON

The appearance of America's highest waterfall is very different in June, when the volume is great and every gust of wind wafts clouds of spray along the rocky hillsides. The Upper Fall alone is nine Niagaras high, the Lower Fall is 320 feet, and the total drop from crest to river, including intervening cascades, is nearly half a mile. The dark markings on the face of the cliff give an idea of the spread of the falls during the high-water season.

Official Photograph, U. S. Army Air Service

A NEW ASPECT OF A FAMOUS NATURAL WONDER OF THE WEST: HALF DOME ROCK, YOSEMITE NATIONAL PARK

"The great Half Dome thrusts its stupendous bulk to an elevation of more than 8000 feet above sea-level; from its crest it is nearly a mile to the floor of the valley beneath. This tremendous block of granite resembles a monster boulder partly imbedded in the canyon wall, and with an entire half cleanly split off. One wonders what has become of the missing half. Was it broken up and washed away? There are no signs of it in the valley. We had long heard of the beauties of Yosemite; from our lofty position over it, we looked down and marveled at the prodigality of Nature in supplying a relatively small valley with so many wonderful features. This region was so attractive that we flew back and forth several times and at last left it with reluctance."—*Stevens and Macready.*

right, and the pilot sits in an unnatural position. I thought the change would be for a minute or two, just long enough for Kelly to change his position or adjust his maps, but instead I flew from behind for more than a half hour.

I was getting a bit provoked, to be left with the responsibility of keeping our course in this uneven country under the adverse personal flying conditions, and thought that my partner should not have shifted this very difficult position on me, but during this period Kelly was doing a very creditable thing, the importance of which cannot be overestimated.

The ignition voltage regulator had been registering "discharge," which meant that we were flying entirely on our batteries, and we would use up these batteries in a very few hours, making a landing necessary and causing failure of the trip. Kelly took off this voltage regulator in flight, a very delicate operation, even on the ground, and adjusted the breaker points within the mechanism, so that it registered "charge" instead of "discharge," and replaced the part again.

OVER THE HOME FIELD AT DUSK

We arrived at Dayton about dusk and changed controls at this point. The *T-2* was ahead of schedule.

Dayton was our home station, but few people saw us go by. The personnel at McCook Field (see page 21) expected us to circle the hangars or do something of that sort, but we had considerable flying to do and were anxious to be on our way out West.

It was somewhat misty around Dayton. A short distance west the clouds began to gather. Flying ahead into this murky night was about the same as plunging into ice-cold water with a long swim ahead.

Our intention was to fly close enough to the south of Indianapolis to distinguish the lights of the city in the distance, and then rely on our compass and wits to bring us through the long night.

On our first attempt, from west to east, we were traveling against light or time; on this flight we were moving with the darkness which made the nights much longer.

People ask us how we kept our course at night. I do not know exactly. It is a combination of luck, good detective work, and judgment. The compass is the main reliance in maintaining a general direction, but there are other agencies used to check the line of flight and correct the compass readings, which may be greatly changed as flight progresses, because of wind drift, compass oscillation or swing, and other causes.

The pilot may see bonfires on the ground and observe the direction of the smoke; he may see the smoke blowing from the chimneys of a factory, and correct his course to provide for this wind drift. He occasionally sees the flicker of automobile lights on the roads, and in the early evening can usually pick out a national highway from the less important routes of travel, by consideration of the number of headlights.

These checks, used in connection with the compass, which is the main basis for night travel, usually give the line of flight. The topography of the ground itself is totally black.

There was but one road between Indianapolis and Terre Haute on which we could see the lights of occasional automobiles. This road appeared to parallel our compass course. Although not entirely certain of its destination, we used it as a general guide.

The definite checks for the course are the lights of big cities, although these are not seen in bad weather until the pilot is within a few hundred feet of them.

We were flying low, at about 800 feet elevation. No objects were distinguishable except lights, as heavy clouds cut off the moonlight. We passed over Terre Haute. It was on our course and was recognizable in the darkness by a river going through the center of the city, with lights on either bank.

A FRIENDLY SEARCHLIGHT IS SIGHTED

The next distinct checking point on our course would be St. Louis. We had lost the lights of the national highway and had nothing with which to check our compass. We were flying in a sort of light mist, under heavy clouds.

Shortly after leaving Terre Haute I noticed a dim flicker of light on the propeller in front. I thought that it was Kelly squirting his flashlight out of the side of the ship to see if the siphon pump

Official Photograph, U. S. Army Air Service

THE AVIATOR'S SIDELONG GLANCE AT MOUNT WHITNEY, 14,501 FEET, LOFTIEST SUMMIT OF THE UNITED STATES OUTSIDE OF ALASKA

"Mount Whitney differs from all other mountains that we have seen, in that it is one of a series of prominences located on a broad, extremely high base. This base is a part of the main body of the Sierra Nevada Range, extending far to the north and south; it comes up rather gradually from the west and is several miles wide on top, dropping off quite sharply to the east. A tail wind was carrying us along at 14,000 feet and the ground was passing uncomfortably close underneath at the rate of 140 miles an hour, or better than two miles a minute. Owing to some peculiar down currents, the plane was unable to rise above the top and it was necessary to skim very close to the surface of the mountain adjacent to the highest peak."—*Stevens and Macready.*

XUM

Official Photograph, U. S. Army Air Service

PRECIPITOUS PEAKS WHICH RISE TO A HEIGHT OF FROM 12,000 TO 13,000 FEET, WEST OF MOUNT WHITNEY

None of the country shown, over which one must fly in crossing the Sierra Nevada Range at this point, is less than 11,000 feet in elevation. In a hollow among the summits is seen a sapphire jewel—a mountain lake.

Official Photograph, U. S. Army Air Service

LOOKING DOWN ON THE BUTTES THAT BORDER ON THE SOUTH THE RESERVATIONS OF THE HOPI AND NAVAJO INDIANS

"The tops of these cliffs are covered with a peculiar light vegetation which, from a high elevation, is a silvery gray, resembling a mosslike growth. This is the region of the cliff-dwellers, and for countless centuries Indians have lived peacefully in this semiarid land. To a large extent civilization has left them unaffected."—*Stevens and Macready.*

were leaking. This faint flicker seemed to come regularly and grow stronger. In a few minutes it changed to a large, white, ghostly ball, appearing and disappearing at regular intervals in the mist or cloud ahead of the plane, in front of the propeller. It was a surprise and shock, as it apparently came from nowhere.

A little later, when we were 70 or 80 miles from Belleville, a mysterious shaft or beam of whiteness, apparently coming from some far-distant point, broke through the black clouds and mist ahead and swung from one side to the other across the sky in front of the *T-2*. It would come from the left, swing quickly by, and then go out of sight to the right.

I could not see the light from which this streak came, but after a few minutes of figuring I began to wonder if it could come from the giant searchlight on top of the dirigible hangar at Scott Field, Belleville, as I remembered that something had been said about wiring to have this searchlight play in our direction during the night. It did not seem possible that this searchlight could make an impression

Official Photograph, U. S. Army Air Service

THE SOUTH BANK OF THE COLORADO RIVER JUST ABOVE AND AT THE ENTRANCE TO BOULDER CANYON (SEE ALSO ILLUSTRATION ON PAGE 66)

"It will require more money than was spent in the construction of the Panama Canal to harness the Colorado for irrigation and power. . . . Traveling over this desert region we could but wonder what we would do if we were forced to land either in the canyon itself or on one of the rims of the high plateau region."—*Stevens and Macready.*

through the poor visibility for such a long distance.

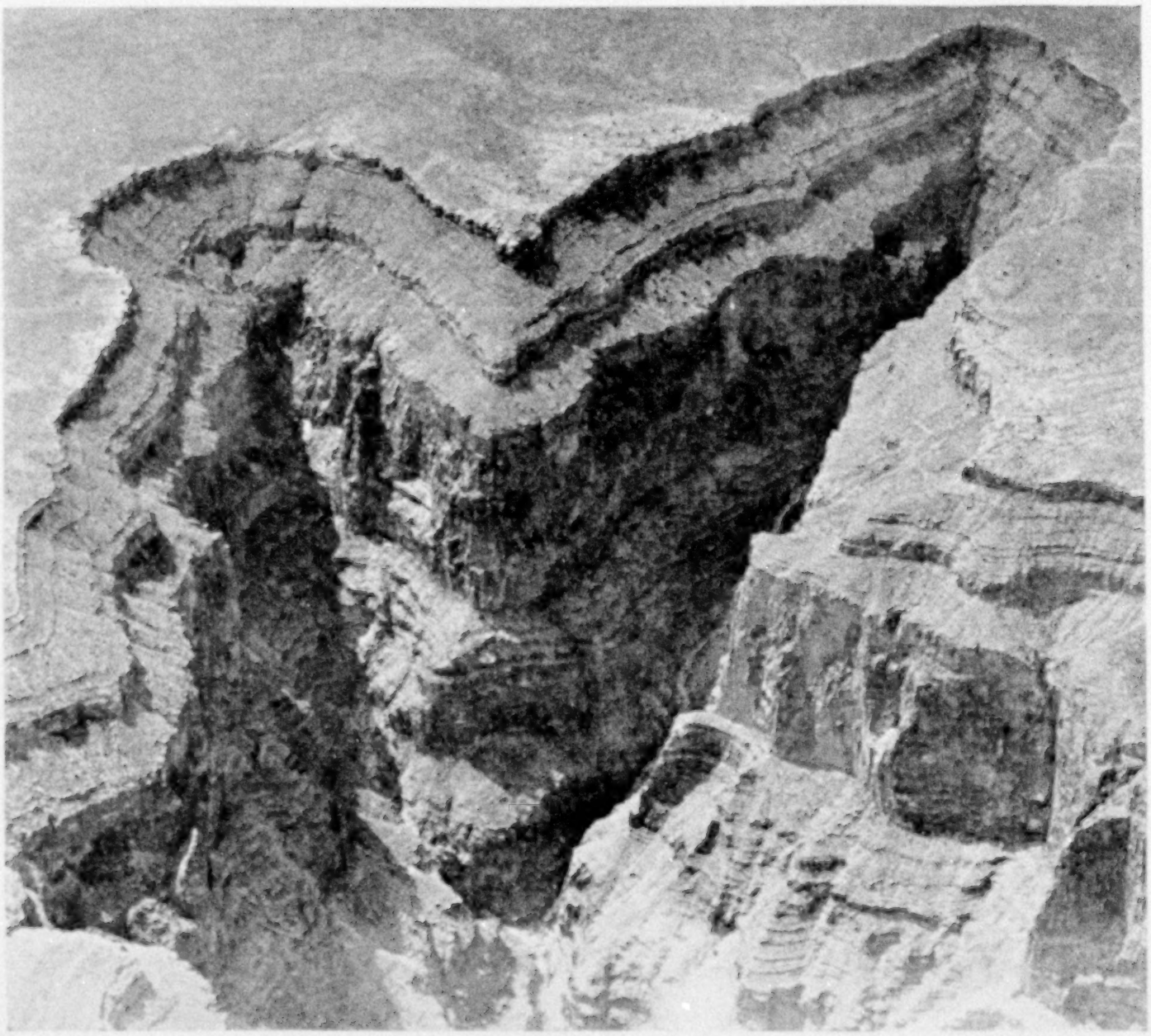
Shortly after, we could see the light from which this long shaft or beam came. We headed in that direction, although originally our intention was to go to the north of St. Louis, as Scott Field was a bit off of the course. The light looked too sociable for a couple of lonesome pilots, and we could not resist heading in that direction. We passed over Belleville, where we knew our friends below were hoping for the success of the attempt. It was an oasis in the desert. They threw the light on the *T-2* as we shot out in the blackness south of St. Louis, toward the foothills of the northern Ozark Mountains.

The Missouri River runs into the Mississippi at St. Louis. Its course above St. Louis lies to the west and slightly south.

Only the suburbs of St. Louis were dimly noted in passing. An impression of the city was obtained by a faint glow in the sky to our right.

It was our intention to skirt south of St. Louis, and then check on the mists which follow the course of the Missouri River until we could see the lights of Jefferson City, Missouri.

The atmosphere was foggy and murky around St. Louis. After leaving the vicinity of the city, only occasional lights appeared, the mist and clouds settled lower, and a drizzle of rain began to



Official Photograph, U. S. Army Air Service

AWE-INSPIRING WHEN VIEWED FROM THE SURFACE, THE GRAND CANYON REVEALS NEW GRANDEURS THROUGH THE AIRMAN'S CAMERA

For a description and map of the great gorge of the Colorado, a glimpse of which is here given west of El Tovar, see "Surveying the Grand Canyon of the Colorado," by Lewis R. Freeman, in the NATIONAL GEOGRAPHIC MAGAZINE for May, 1924.

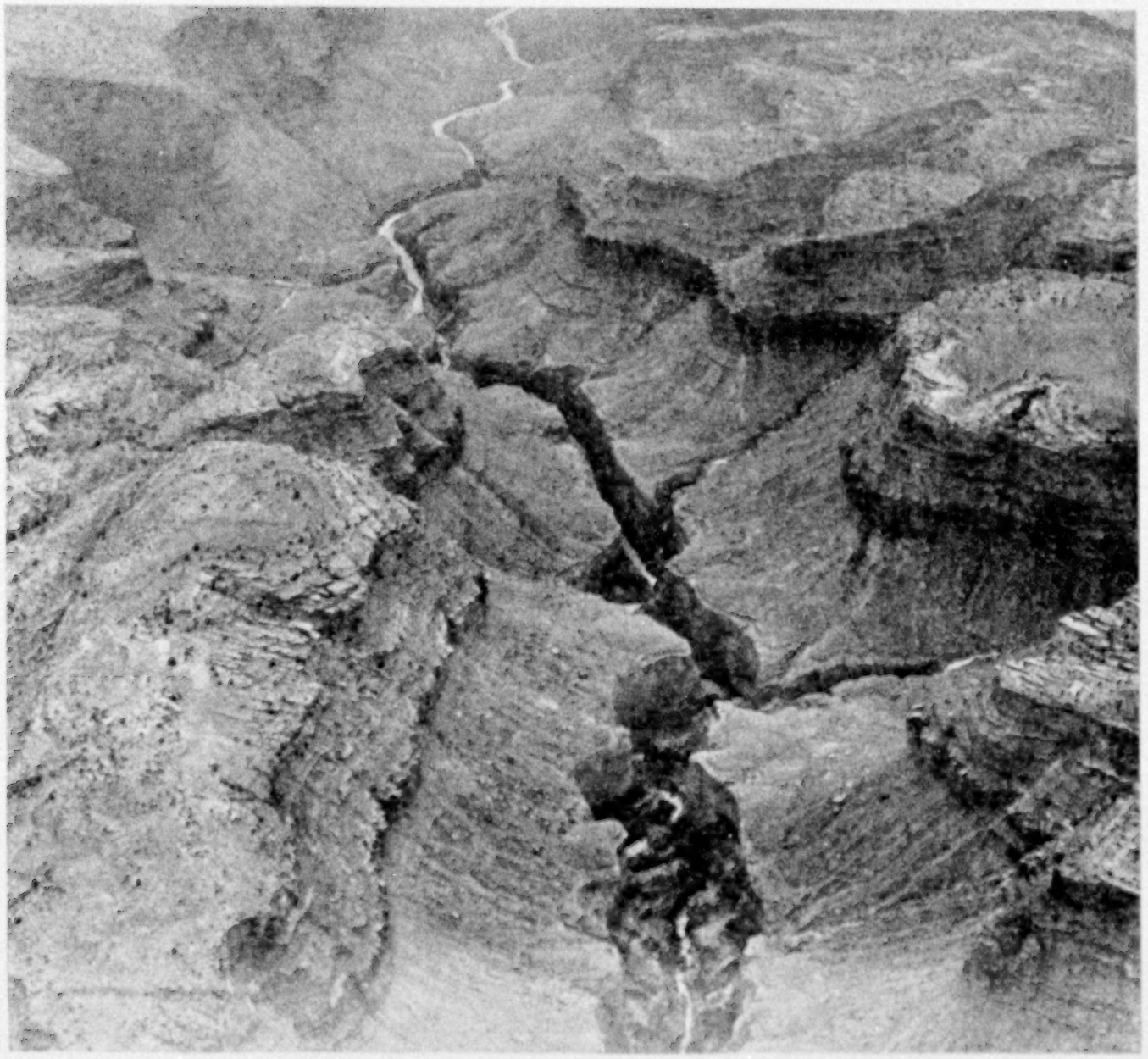
fall—not heavy, but just enough to cause considerable discomfort and necessitate the continual wiping of our goggles. When we were over the northern part of the Ozarks the lights became very few. We would see three lights, then two lights, and finally but one light; then this last light would disappear.

UNCERTAINTY OF FLYING IN DARKNESS

Few people realize that flying is practically impossible unless there is some exterior fixed point that the pilot may use to obtain a sense of balance or position. If there is no horizon, no light nor any fixed object, a pilot cannot tell the position that the plane is in except from the instruments in the cockpit. When the lights all disappeared, there was nothing to do but watch and fly by the instruments alone. It did no good to look outside; there was nothing to see but opaque blackness.

A pilot can fly by the instruments for a certain length of time, probably 15 minutes, but he would be very apt to become confused and lose his sense of balance entirely if there were no fixed point that he could see within 20 minutes.

The pilot watches the air speed instrument, he watches his compass, he watches his bank and turn indicator, and he must



Official Photograph, U. S. Army Air Service

A LOFTIER VIEW OF THE GRAND CANYON WEST OF EL TOVAR (SEE ALSO PAGE 64)

be watching them all at the same time. When the air speed becomes very great, he knows that the nose of the airplane must be pointed downward to cause acceleration, and when it becomes very slow he knows it must be pointed upward and may stall. When he sees the compass begin to swing, he knows the plane is turning, but there is nothing fixed on the outside to tell how many turns he is making, whether he is making a quarter of a turn or whether he is making four turns.

IMPOSSIBLE IN DARK TO TELL IF PLANE IS LEVEL

There is no object to pass by a certain number of times or to indicate where or when to stop.

It takes considerable time for a swinging compass to become still and adjust itself. While the compass needle is swinging, the plane may be continually turning without the knowledge of the pilot.

Neither can the pilot tell, except by his instruments, whether one wing is pointed toward the ground and one toward the sky, or whether they are in a horizontal position; and these different positions and conditions must be coördinated and watched simultaneously.

The absence of an outside fixed point or lights would last for two or three minutes, and then another light would appear in a window of some isolated farm house in the foothills.

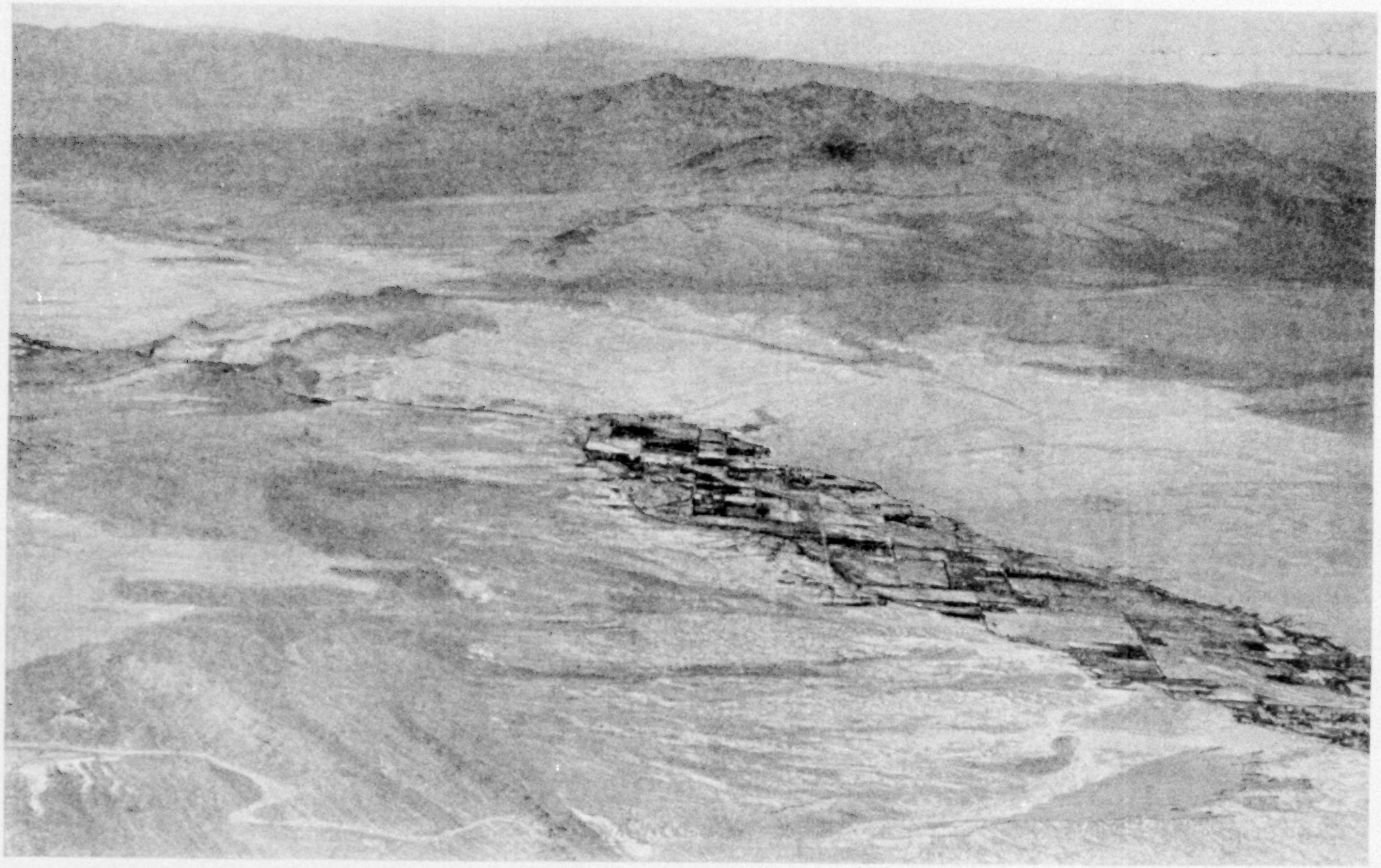
This period was a very trying one during the transcontinental flight—in fact, the most trying of all for me.

The drizzle was continuous and we

Official Photograph, U. S. Army Air Service

BOULDER CANYON OF THE COLORADO IN THE MIDDLE FOREGROUND

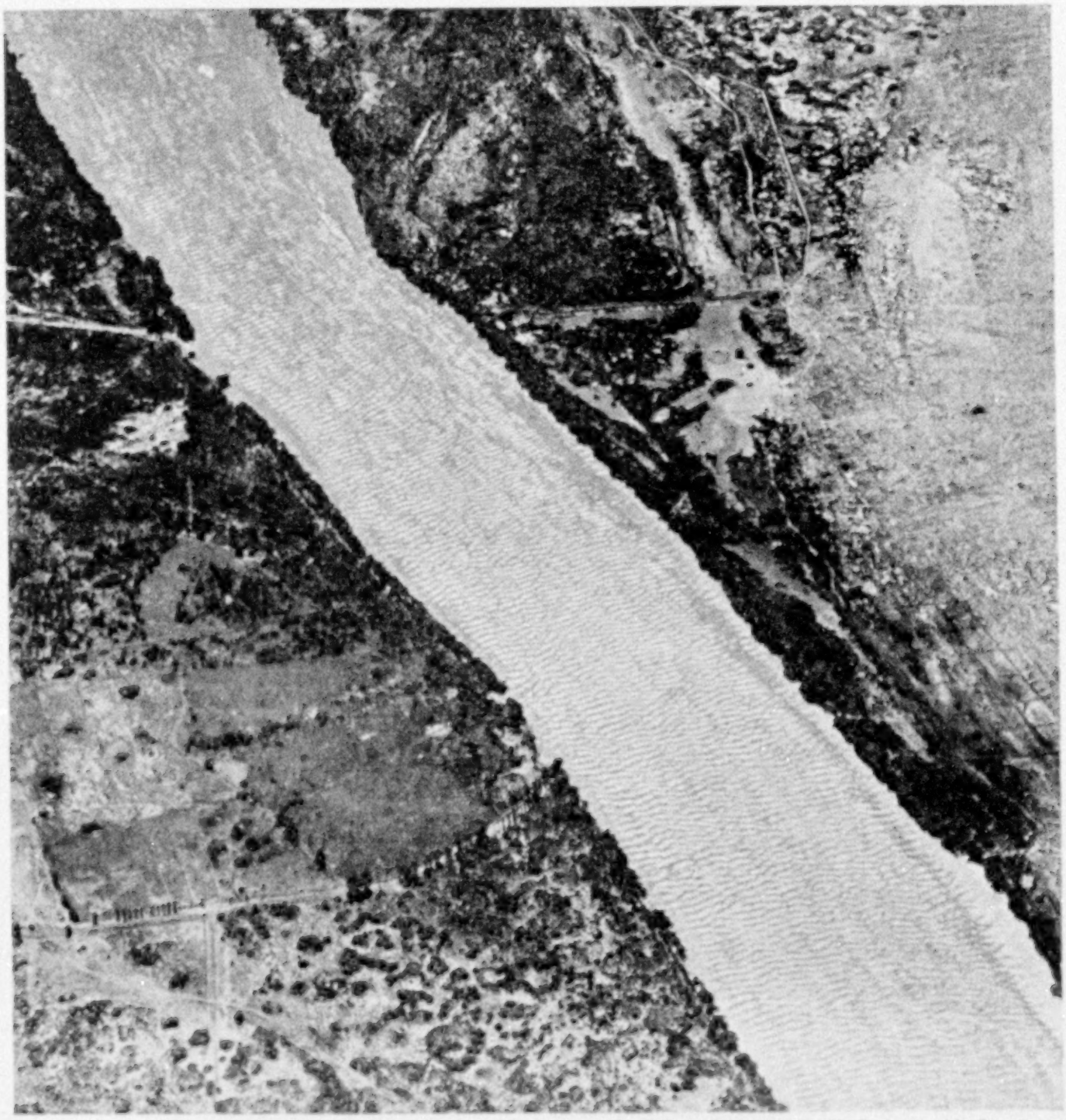
This view is made looking east, up the Colorado River. Although this canyon is not very long, it is narrow and high, and the rock formations are such that it offers one of the best dam sites on the Colorado. In the distance, on the left, the Virgin River enters from the north. If proposed engineering plans materialize, the area in the picture beyond the walls of the canyon will be a tremendous reservoir, 600 feet deep and 90 miles long. From 250,000 to 500,000 horsepower can be developed for distribution among the people of California, Arizona, Nevada, and Utah.



Official Photograph, U. S. Army Air Service

WHERE A LONG GREEN AND BLACK FINGER OF FERTILITY HAS BEEN THRUST OUT INTO THE DESERT SANDS

In the valley of the Virgin River Mormon farmers have worked indefatigably to wrest soil from the surrounding wastes of sand, and bit by bit they have added cultivated field to cultivated field. If the Boulder Canyon dam project materializes (see page 66), these farms will be moved, for the reservoir will cover this part of the valley under 600 feet of water.



Official Photograph, U. S. Army Air Service

A VIEW MADE LOOKING ALMOST DIRECTLY DOWN ON THE COLORADO RIVER AT A POINT BELOW BLACK CANYON

At first sight one would think that the appearance of the river is due to waves caused by the wind. In reality the waves shown are ripples of mud made as the heavily silt-laden waters of the river flow rapidly over comparatively shallow stretches. These waves are from 15 to 30 feet apart and are 3 to 5 feet in height.

were within 400 or 500 feet of the ground, in darkness and mist.

Many people imagine that automobile driving and airplane flying are very similar. Driving an automobile is entirely mechanical; flying a plane is done almost entirely through the senses, the sense of balance being predominant; and this is obtained through adjusting the airplane with reference to some outside fixed point.

I, personally, believe that if there is no fixed outside point or horizon, no one can tell his position, whether upside down, straight up, or crosswise, except when the force of gravity pulls him away from or toward the plane.

We indistinctly saw the lights of Jef-

Official Photograph, U. S. Army Air Service

"THE LONGED FOR OPENING APPEARED AND WE FLEW THROUGH"

"But instead of the friendly valley which we expected would lead us to Phœnix, Arizona, we found the country ahead broken up with canyons, ravines, and high, sharp volcanic mountain ranges" (see text, page 75).

ferson City, passed slightly to the south, and headed straight from that point by compass for Tucumcari, New Mexico, five States distant.

Later I read in the press reports and in the news reels of the "movies" that we were checked in at Kansas City. A policeman at Kansas City stated to the newspapers that while he was walking his beat at midnight he heard a powerful roar overhead and graphically described how he saw us fly by in the darkness, with fire spurting from our exhaust stacks.

We did not get near Kansas City; in fact, were at least 75 or 80 miles distant at our nearest point. Kelly and I take great pride in having remained directly on our course throughout the blackness of the night, and do not like being sent from Jefferson City straight up to Kansas City and straight down again to continue on our course (see map, page 6).

OUT INTO THE MOONLIGHT AFTER MIDNIGHT

A little after midnight we suddenly came out from under the dark, dismal clouds into the bright moonlight. It was a very welcome sight to see the big, cheerful moon shining overhead. We could dimly see the section lines on the ground

Official Photograph, U. S. Army Air Service

LOOKING DOWN ON DEATH VALLEY FROM A HEIGHT OF 12,000 FEET

"Even at the high elevation at which we were flying, at intervals we could feel waves of heat from the valley. For total desolation there is nothing that approaches this basin and its surroundings. On each side are black, sun-baked mountains that rank probably among the most dismal, and in summer time the hottest, places on earth."—*Stevens and Macready.*

and could judge our direction and drift from them.

Kelly now took the controls and flew the plane to Santa Rosa, New Mexico. I cannot tell his experiences while he was flying. I know that he took the plane when our exact location was somewhat of a conjecture, although supposedly on the course, and brought it out in the morning exactly where we wished to be.

I remember the immense fields and plains of Kansas passing underneath in the ghostly moonlight, with occasionally the twinkle of lights of towns and settlements in the distance, like little groups of stars, the meteors and shooting stars occasionally speeding across the great dome of the heavens, and then the ghostly pallor just preceding the dawn.

The break of day looked good to us. One imagines the dawn is coming long before it really appears. The eyes are strained to see a brightening of the sky in the east, and hope distorts the true appearance of the horizon.

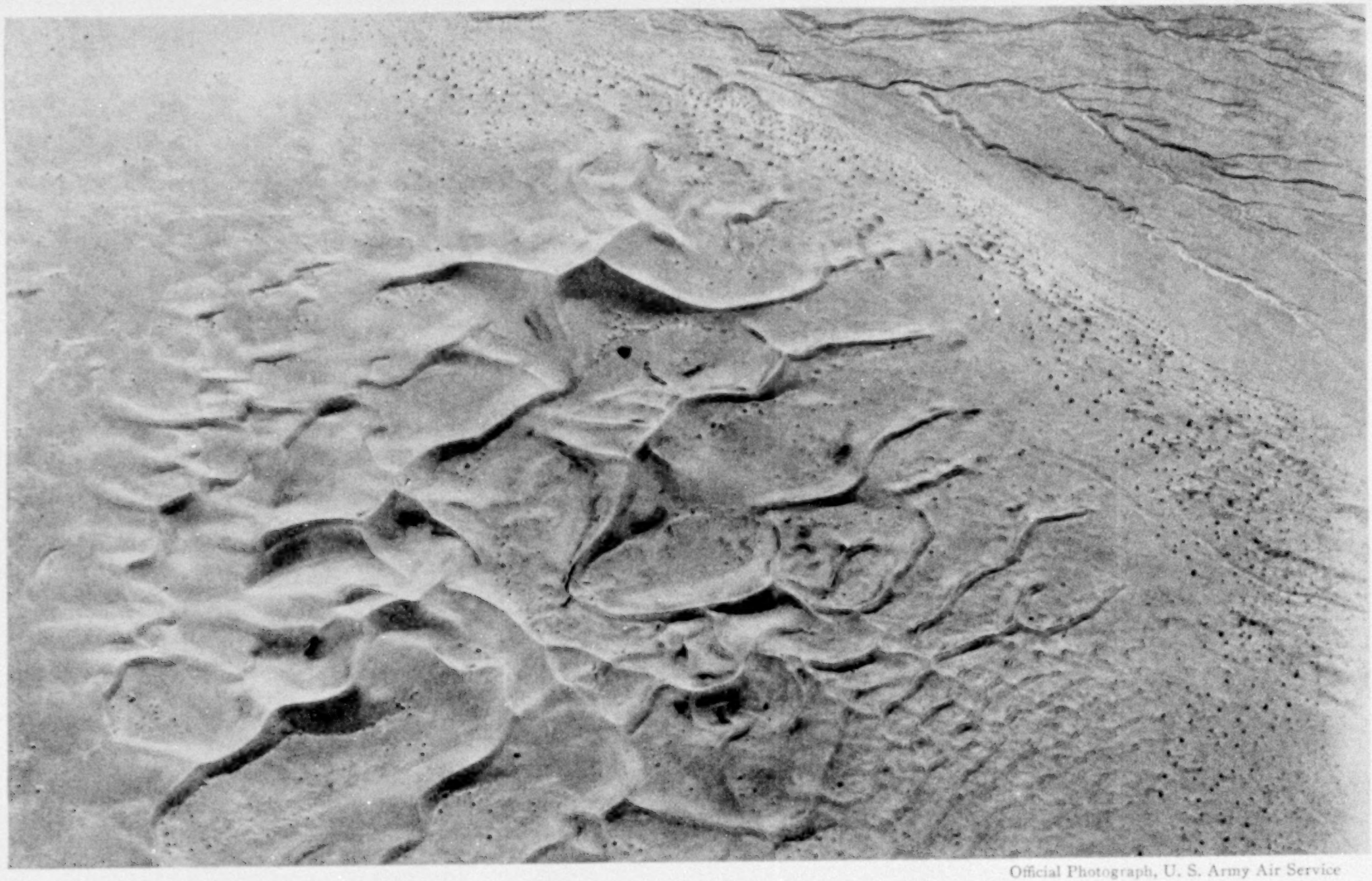
The fields of Kansas merged into the grotesque buttes, little flat-topped plateaus, and eroded topography of New Mexico, with its pastel shades intensified in the eerie light of early dawn.

There is a period just before sunrise when the earth is in shadow, while the sky is light. I was looking below, trying to distinguish details of the natural features on the ground, indistinct in the pinkish pallor which seemed to cover it as a sort of pall. Without especial interest, I noted square little cubes of earth which seemed to be arranged regularly by nature and I wondered what process of erosion could have caused this peculiar arrangement, when, with somewhat of a shock, I recognized these little squares of earth as the adobe huts of Indians.

Official Photograph, U. S. Army Air Service

DRY CANYON, IN DEATH VALLEY, CALIFORNIA, OPPOSITE FURNACE CREEK

Aërial camera men speak of "verticals" and "obliques" as the studio photographers talk of "full lengths" and "bust portraits." The "verticals" are views taken in the position the name implies, and are especially valuable for mosaic map making, while the "obliques" bring out perspective, which makes for scenic beauty. In this picture the camera was held obliquely, but the canyon walls rise so steeply that the general effect is that of holding the camera "square" with the ground.



Official Photograph, U. S. Army Air Service

AN AMERICAN SAHARA FROM THE AIR

Huge sand dunes in the floor of Death Valley, California, are formed, reformed, and ever change, because of the air currents that sweep in from the adjoining canyons. Sometimes these dunes are 200 feet high. Looking down upon the valley floor, the aviator can see a dozen or more whirlwinds, denoted by the clouds of sand. "Death Valley from the air does not differ in appearance from valleys immediately adjoining it on either side. It is, however, considerably lower. Most of it is at about sea-level, but near the center, over which we passed, there is a sink that is depressed 271 feet below the level of the sea, and is the lowest point of dry land in the United States. Just to the north of this sink, Furnace Creek enters the valley from the Funeral Range on the east, but, except for brief periods immediately following heavy rains, which are extremely rare, there are no signs of water in either sink or creek."—*Stevens and Macready.*

XUM

Official Photograph, U. S. Army Air Service

A VIEW OF THE MINING TOWN OF SEARCHLIGHT, NEVADA, SURROUNDED BY SAGEBRUSH AND DESERT

In the course of his and Lieutenant Stevens' survey of America, Lieutenant Macready made this photograph of the community where he presided as a justice of the peace before enlisting in the aviation service (see text, page 86).

It was Tucumcari, New Mexico, our first known point after the night. We reached it at the break of day and recognized it, both by the huts and the graveyard, for we had been over Tucumcari before (see page 37).

"JOY COMETH IN THE MORNING"

The sunrise gave us a glorious feeling. When we saw the little Indian town below we knew that our flight had been well planned. We had delayed the start two hours at New York to avoid being farther west than the town of Tucumcari at dawn, and it was remarkable that we were at this point at this time.

The next little settlement was Santa Rosa. We changed pilots here. For a considerable time the flying was comparatively easy. A railroad could occasionally be seen in the distance and supplied a means of checking the course. We last saw this railroad shortly before we reached the Rio Grande.

We flew west, high above the Rio Grande, meandering below us like a dirty, muddy thread in this barren volcanic land of jagged dry rock and sand, and headed toward a winding and irregular pass leading to the summit of the rapidly ascending slope.

It was our intention to fly due west, to a point about 20 miles south of the little Mormon and Indian hamlet of St. Johns, Arizona, and from this point change our compass to fly southwest (see thin arrows on map, page 6).

Although we were following the lowest topography of the ground, as shown by our contour maps, this southwest course would increase our elevation somewhat, until finally we would reach a precipice which was the rim of a large valley or basin leading to Phœnix, Arizona, 200 miles distant.

When we arrived at this point, south of St. Johns, we were in the lowest part of a very large, high plateau or valley, were as high as the plane would go, and the ground in the direction of our intended course to the southwest was much higher.

While we were approaching to the south of St. Johns the ground had been coming up beneath us faster than the plane could climb, until we were very close to the surface and the *T-2* was at its utmost elevation. As each gallon of gasoline was consumed we would get a few more feet elevation, but it was a question of which would win out, the ground coming up beneath us or the slight increase of altitude, due to the lessening weight as the gasoline was used up.

Our maps had shown the country in this vicinity to be about 8,000 feet in elevation. Our altimeter registered 10,000 feet, or 2,000 feet more. Ten thousand feet was right, as this was an unsurveyed region, and the altitude was higher than that indicated on the map.

"LAVA BEDS" PROVE TO BE AN IMMENSE FOREST

Looking out to the southwest, I could see the route that we should take, according to our maps. There was a gradual upward slope, the higher and distant part of which appeared to be covered with some blackish material which I thought was lava.

It was useless to attempt this route, as the plane would not climb high enough to get over. The only thing that we could do was to keep flying straight ahead in a westerly direction, following the lower position of this high plateau or valley. This course almost paralleled the black lava masses dimly seen at a great distance to our left, where we imagined the high rim or precipice of the big valley or basin to be.

We purposely left our course to follow the low places, but eased over to our left when opportunity offered.

The high plateau was a very picturesque country. To the right were the black volcanic lava beds, with the old extinct black craters occasionally seen. The coloring was beautiful. The ground was red and pink. There were small, flat-topped plateaus, with strata of yellow, gray, and pink soil running parallel with the flat top.

After flying for a considerable distance over this plateau, we deflected our course to the left, hoping to get over the higher areas. As we approached close to the black mass which we had imagined was a lava bed, we were greatly surprised to find that it was an immense forest of stately trees. I had never imagined that there was such a large forest in the United States.

Official Photograph, U. S. Army Air Service

A GRAVEYARD SURVIVES IN THIS FOREST OF OIL DERRICKS

Signal Hill, Long Beach, California, has been usurped by oil wells, but the cemetery seen in the lower right corner of the picture was not permitted to be disturbed.

It was impossible for the *T-2* to negotiate the highest point or rim of this tree-covered slope, although the plane was flown to within approximately one or two miles of its higher outer edge. For 75 or 80 miles we flew just above the tops of the trees paralleling the rim to the left, hoping for a low place that would permit us to fly through to the basin or valley on the other side, which would lead us to Phœnix.

SKIMMING THE TREETOPS SEEKING AN OPENING

We were within 100 feet of the tops of the trees, sometimes even less than this. We knew that we were not flying the course that we wished, but it was unavoidable. For almost an hour the *T-2* skimmed above the treetops, their dense growth occasionally broken by canyons and rivulets, with the white glint of a waterfall seen from time to time.

Finally the longed-for opening in the higher ground to the left appeared. Imagining that our troubles with elevation were now at an end, we eagerly flew through; but instead of the friendly valley, with green cultivated fields and farms, that we had expected, we found the country ahead broken up with canyons, ravines, and high, sharp volcanic mountain ranges.

I was nonplussed. It was like hunting

Official Photograph, U. S. Army Air Service

AN OIL TANK FARM AT LONG BEACH, CALIFORNIA

The large, oval-shaped objects in the foreground are covered lakes of oil (see also illustration, page 77).

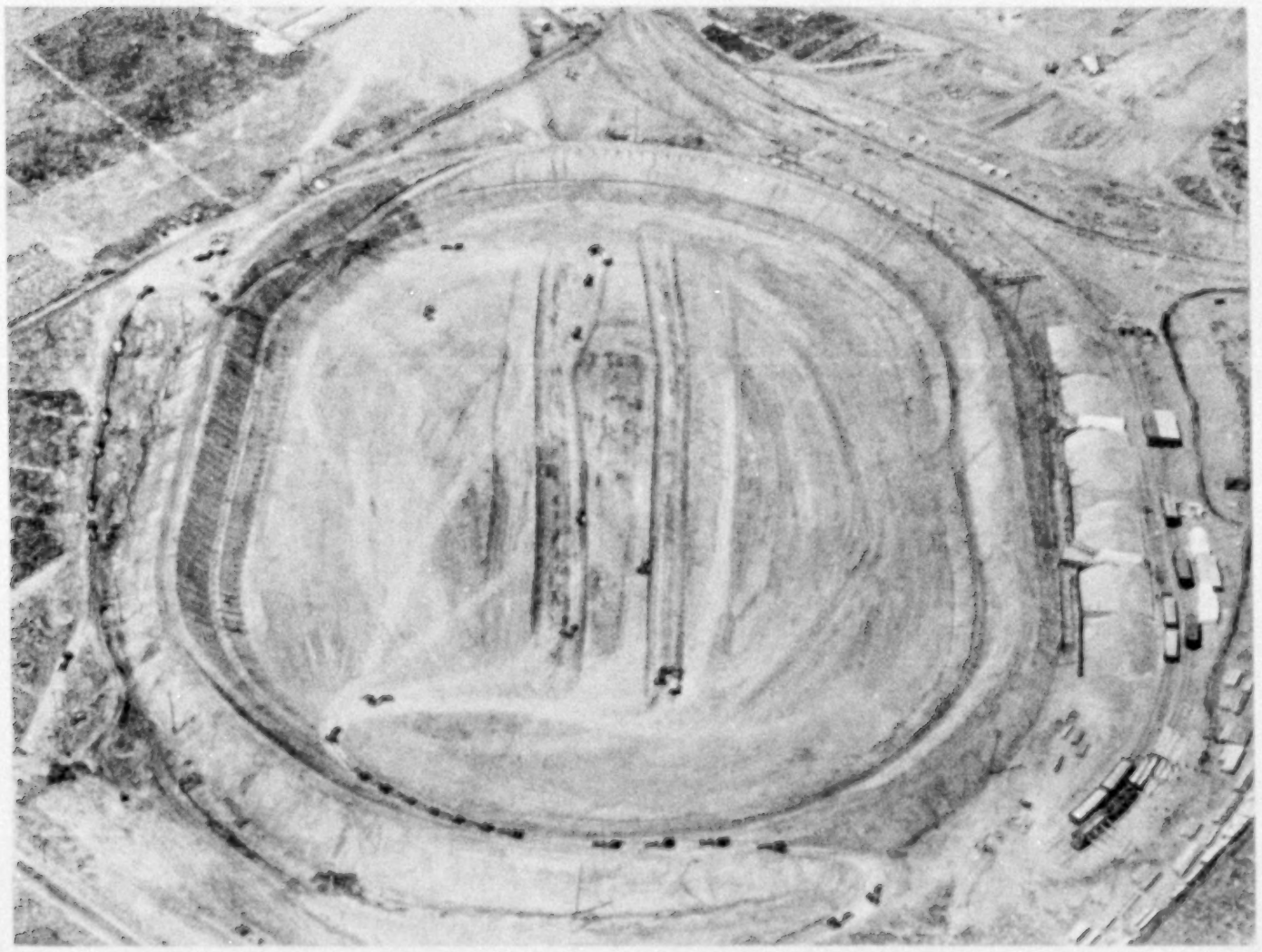
for a needle in a haystack to tell which of these canyons would lead us to Phœnix, and some of the mountain ranges were too high for us to cross.

I was afraid that, should we follow one of these canyons with the enclosing mountains higher than our path of flight, we would be pocketed between the ranges and would be unable to turn in the small radius and get back and out.

We decided to fly due west for the Pacific coast, tending our course a trifle to the south. It was not easy to tell what was west, as the compass variation at this point was great. The *T-2* crossed the less high ranges and partially followed the ravines in a westerly direction until finally we crossed over a range and the desert lay before us—barren wastes of sand and volcanic rock.

CROSSING THE IMPERIAL VALLEY AND THE LAST MOUNTAIN RANGE

Although our approximate location was known, our exact position was not certain. Kelly took the controls shortly after this and again picked up our position, when we sighted the Santa Fe Railroad near Wickenburg, Arizona, northwest of Phœnix. Wickenburg did not look like much from the air—a couple of box cars, a desert store or two, and some dilapidated shacks—but it served its purpose and let us know where we were.



Official Photograph, U. S. Army Air Service

EXCAVATING FOR A HUGE OIL TANK, OR LAKE, AT LONG BEACH, CALIFORNIA

When he goes aloft the airman becomes a sort of Gulliver looking down upon the puny labors of Lilliputians. Note the train of trucks winding out of the immense hole which resembles a vast amphitheater.

The hot, barren wastes of the desert passed beneath, and soon the muddy Colorado River could be discerned far below (see pages 63-66 and 68). The Colorado was crossed, the panorama changed, and green fields replaced arid sands.

Imperial Valley, with its green fields and small, hot-looking cities, was a beautiful sight to us.

One hardly realizes what a vast empire the Imperial Valley is until seen from the air. We quickly skimmed over it, crossed the dazzling whiteness of the mammoth wash, and then pointed the nose of the ship upward to climb the last high, rugged mountains between us and the Pacific coast.

THE GOAL IN SIGHT

We changed pilots just after crossing the high mountains. The *T-2* was 8,000 feet high and San Diego lay beneath us in the distance (see page 81).

When I think back now, I wonder why we did not get more of a "kick" from our first sight of San Diego. It did give me a very pleasant feeling, to think that the terrific strain and hard work would soon be over, but I was not particularly excited about it. In fact, I believe if a careful analysis of my feelings were made, I was just a little bit irritated that no one was paying any more attention to us.

We felt like we were absolutely alone, and that the world was going on beneath us with no thought of us. Rain and storm at night, mountains, forests, and barren desert wastes had been crossed without sign of life, leaving the impression that the continent was practically uninhabited, and that we were isolated and forgotten.

The strongest impression of the United States obtained from the panorama of this transcontinental non-stop flight was

Official Photograph, U. S. Army Air Service

LOS ANGELES' NEW STADIUM SEEN FROM THE AIR

This immense municipal structure, completed a year ago in time for the Monroe Centennial, could seat the entire population of the State of Nevada and have a few thousand places to spare. The stage in the center can be removed when desired.

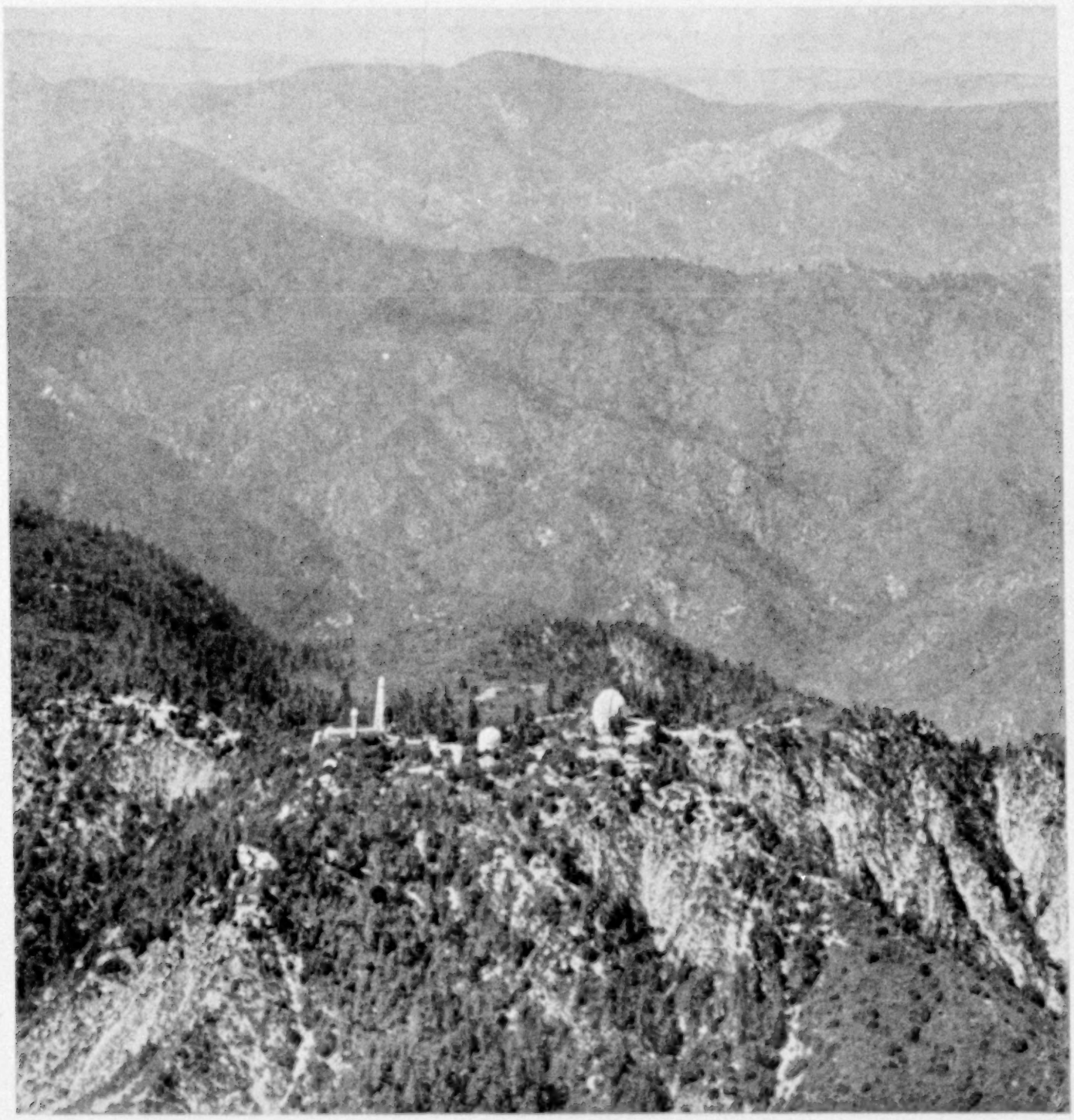
the immensity of the lonely, isolated territory which passed beneath us. Travelers and tourists follow auto roads and railroads, and the population stays close to them, but the area seen from the air is practically without human life. Occasionally an Indian village or mining town was seen, but mostly stillness and solitude.

As we wished to reach Rockwell Field and land in less than 27 hours, we contemplated no flourishes over the city of San Diego.

Diving down from 8,000 feet with power on, we reached San Diego, cocked the *T-2* up on the wing to swing down the main street, and passed about 100 feet above the tops of the buildings

I noticed something black on top of these buildings and was greatly surprised to observe that it was people. This was our first impression that there was still life on the earth. We learned afterward that one of the prominent citizens of San Diego became so excited when he saw us come swooping down that he took his coat off, waved it over his head, and threw it out in the middle of the street from the top of one of the city's skyscrapers; another broke a brand-new straw hat by beating it on the railing.

We wasted no time. The Army Air



Official Photograph, U. S. Army Air Service

GAZING DOWN UPON MOUNT WILSON, CALIFORNIA, WHERE MANKIND RECEIVES NEWS OF THE STARS

With the aid of the world's most powerful telescope, the astronomers at this observatory can take pictures of the moon which are the equivalent in detail and appearance of those an aviator would obtain were he to fly within 40 miles of our satellite. Indeed, photographs of the moon such as those in THE GEOGRAPHIC for August, 1919, bear a striking resemblance to air photographs of the lava beds of southern Idaho, which have been named "The Craters of the Moon" (see THE GEOGRAPHIC for March, 1924).

Service transport made one turn of North Island, to head into the wind, and landed exactly 26 hours and 50 minutes elapsed time from Long Island, New York.

THE END OF THE FLIGHT

Every one was excited but Kelly and myself. We had been working in grease and dirt, without rest, for such a long time previous to the flight that we had not had opportunity to think about it from the standpoint of an accomplished act.

It seemed to us that we had just finished a hard test flight, and we were mighty glad that it was over. We had been so busy with endurance flights, lack

Official Photograph, U. S. Army Air Service

AN ELABORATE SETTING FOR A MOTION PICTURE, SEEN FROM THE AIR

A bit of make-believe Mesopotamia built in southern California: the ancient city of Arabian Nights adventures recreated to furnish the background for "The Thief of Bagdad."

of sleep, and work in connection with the project that neither of us had had time to think of anything else; so we did not realize after we landed that we had done anything much out of the ordinary.

A handful of telegrams was given us, and then another and another. Many were from prominent people. President Harding, General Pershing, members of the Cabinet, and others sent congratulations. We could not read them all in the excitement. One was handed to me separately, which I at first read as a joke, but when told that it was authentic reread. It said:

> Col. Franklin R. Kenny, former executive officer of the Air Service, has won a bet of $5,000 on your flight, which he tenders to you, with his respects, and begs that you accept it.
>
> PATRICK.

This present was certainly a godsend and helped pay our personal expenses in connection with the flight, as the remuneration which we received from the Government was but a small part of the actual money which we were compelled to spend in order to make the flight successful, and had not Colonel Kenny won his bet (see text, page 56), both Kelly and I would have gone considerably in debt in connection with the enterprise.

Honor is its own reward. There is plenty of glory in connection with flights

Official Photograph, U. S. Army Air Service

SAN DIEGO IS THE IDEAL PLACE TO MAKE ENDURANCE FLIGHTS (SEE TEXT, PAGE 18)

of this nature, and considerable satisfaction in doing one's duty as a soldier and accomplishing a feat considered by many to be impossible, but after the glamour wears off, one wonders whether the health and vitality which have been so severely taxed are not of more value than the glory gained.

The coffee and broth in our thermos bottles, filled in New York the previous afternoon, were still hot. It was 26 minutes after 11 in the morning when we landed. We had lunch at the quarters of Major Arnold. Kelly and I were both tired, but neither of us felt any bad effects from the trip.

No sleep was obtained during this or any of the other flights. In fact, the pilot who was in the rear had plenty to do most of the time and had always to be on the alert to take the controls in an emergency. During every shift, the pilot in front would shake the controls and the one behind would fly for a short period, in order that the active pilot might change his maps or rearrange things in front.

A WEDDING AND A BANQUET FOR THE FLYERS

Kelly had an engagement in San Diego that night and I had one in Los Angeles. The American Legion of San Diego had wired us in New York the day before, requesting our presence at a banquet in San Diego the next day, and we accepted the invitation, although we had a little over one day in which to arrive, and the

Photograph by Harry T. Bishop

AT THE END OF THE CROSS-CONTINENT, NON-STOP FLIGHT

"Every one was excited but Kelly (right) and myself. We had been working in grease and dirt, without rest, for such a long time previous to the flight that we had not had an opportunity to think about it from the standpoint of an accomplished act" (see text, page 79). Among the messages received by the aviators upon the completion of their non-stop flight was this from Ezra Meeker, of New York: "Congratulations on your wonderful flight, which beats my time, made seventy-one years ago by ox team, at two miles an hour, five months on the way. Happy to see in my ninety-third year so great a transformation in methods of travel. Ready to go with you next time."

distance was about 2,700 miles. Kelly was in plenty of time for the banquet.

I had something to attend to myself, and obtained authority from Major Arnold to be present at a wedding in Los Angeles, which was to take place a few days later. It was my own wedding. I was married that week. This was certainly a good week for me. We made the transcontinental flight, acquired $2,500 each, and I became a married man.

Los Angeles is the home of the movies. Even the moving-picture industry must occasionally advertise, and the publicity which we were receiving looked good to them from this standpoint. I was taken

to various studios to get into the pictures and meet the celebrities.

Both Kelly and I expected to get some leave in California, I for a honeymoon and Kelly to rest up, but we received orders to fly the *T-2* back across the continent, stopping for demonstration of the plane en route, and arrive in Washington before June 1. We started back without delay, arriving in Washington in time for the Shriners' Convention, where the *T-2* was placed on exhibition.

THE PLANE IS PLACED IN THE SMITHSONIAN INSTITUTION

This finished the important flights of the *T-2*. It is now reposing in the Smithsonian Institution at Washington, where it belongs. It did its work in excellent shape and deserves a good rest.

We think of the *T-2* as a living object, which came through the tight places with honor, rather than as an inanimate thing of metal and wood.

During the course of our flights with the *T-2* Lieutenant Kelly and I flew a total of five and one-half complete nights, the great majority of which time was in total darkness, either without moonlight or during periods of cloud and storm. On our first transcontinental flight we passed through parts of six States at night and spent 12½ hours in darkness. During the second trip, the one from east to west, we passed through parts of seven States at night and were in darkness for 13½ hours.

On both of these transcontinental nonstop flights we encountered storms and rain at night. This was the condition that we most dreaded. No one had flown at night across country under storm conditions, and we did not know whether a pilot could handle the unknown difficulties which might arise.

The general public marvels at our speed in crossing the continent without landing, and at the fact of being able to fly in darkness, in bad weather, and for such a long period of time without rest; but the experienced pilots of the Army Air Service give us most credit for flying through those long nights and coming out of the darkness in the morning directly on our course. Kelly and I take most pride in that feat of navigation.

We drew a line across the continent on the map and followed it at night and during the day, with our compass the main reliance a large part of the time. We followed no railroad or established air or mail route and kept our course and exact location throughout, except when high elevations forced us temporarily to deflect from this line.

Two "Round the World" flights are now in progress and other noteworthy flights will be made, but it will probably be a considerable time before such a heavily loaded airplane will continuously fly at its ceiling for such a long period of time over rough and rugged elevations and encounter such long periods of darkness and bad weather.

Most long flights are merely a succession of comparatively short trips of a few hours' duration, each one a unit in itself. The pilot has opportunity to rest, repair his plane, and pick his weather, and flies without excessive load or weight. Both Kelly and I, in addition to the long nonstop flights, crossed the continent four times by airplane in easy stages within the same year, and there was little effort in connection with the trips; but the nonstop flights were considerably more difficult.

We feel grateful for the opportunity to attempt the task and very much pleased that by successfully accomplishing our work we fulfilled the trust imposed in us. We made our own decisions, personally developed and oversaw all preparations, and are proud of the fact that the final result showed that the work had been well planned.

INDEX FOR JANUARY-JUNE, 1924, VOLUME READY

Index for Volume XLV (January-June, 1924,) of the National Geographic Magazine will be mailed to members upon request.

Official Photograph, U. S. Army Air Service

THE HIGHEST ALTITUDE PHOTOGRAPH EVER MADE

This picture of Dayton, Ohio, was made by Lieutenant John A. Macready and Lieutenant A. W. Stevens in May, 1924, at an elevation of 32,220 feet—more than six miles above the city and 3,000 feet higher than the summit of Mount Everest. The aviators, of course, used oxygen tanks (see illustration, page 86). They encountered terrific cold, the thermometer registering 62½ degrees below zero. Their plane was visible from the ground for two-thirds of the maximum elevation; after that, its course was indicated for a while by a streak of vapor, like a comet, but for the last 3,000 or 4,000 feet it was invisible and its motor could not be heard.

AMERICA FROM THE AIR

No Such Series of Airplane Views Has Ever Before Been Printed

A PHOTOGRAPHIC survey of America from the air has recently been made by Lieutenant A. W. Stevens and Lieutenant John A. Macready, of the Air Service of the United States Army. In many respects, this reconnaissance of the beautiful and inaccessible natural features of the United States is unique. For the route covered see map on page 6.

The airmen, in the course of eight weeks' flying, covered 10,000 miles and made 2,000 photographs, from which more than 70 illustrations reproduced in this number of THE GEOGRAPHIC were selected, together with descriptive text quoted from their diaries.

The range of photographic subjects includes our greatest cities, our leading institutions of learning, our most majestic waterfalls, the impressive grandeur of the Rocky Mountains, the serene beauties of pleasant valleys, the marvels of the Grand Canyon, and the awesome desolation of our Southwestern deserts.

Lieutenant Macready, a graduate of Leland Stanford Jr. University, with another associate, Lieutenant Kelly, holds the long distance, non-stop air record (see pages 1 to 83 in this number of THE GEOGRAPHIC), the endurance record, and, from September, 1921, to October, 1923, held the altitude record, having reached 34,509 feet. At the outbreak of the World War he left his home in Searchlight, Nevada, for San Francisco, expecting to enlist as a private in the cavalry, but he has said that "a slight flip of fortune changed this decision to enlistment as a private in the aviation section of the Signal Corps."

Lieutenant Stevens, a graduate in electrical engineering from the University of Maine, had his training for the arduous life of an aviator as a mining engineer sent out to prospect for placer gold. He has made two trips of more than 1,000 miles each across Alaska by dog team in midwinter, encountering temperatures of 40° below zero. This, however, was 22½° warmer than the cold which he experienced during his recent flight with Lieutenant Macready, when he succeeded in obtaining the picture reproduced on page 84, at an elevation of 32,220 feet—the world's photographic altitude record. Lieutenant Stevens also holds the world's parachute record, having made a safe landing after a jump of 24,200 feet, nearly five miles.

Among Lieutenant Stevens' many pictures which have been reproduced in previous numbers of the NATIONAL GEOGRAPHIC MAGAZINE were the notable collections illustrating the Reelfoot Lake district of Tennessee (see January, 1924) and "Fighting Insects with Airplanes" (March, 1922).

The Stevens-Macready photographic expedition began at Dayton, Ohio, and the following landing fields were used as bases in obtaining the 2,000 negatives: Iowa City, Iowa, North Platte, Neb., Cheyenne and Rock Springs, Wyo., Pocatello and Boise, Idaho, Vancouver, Wash., Red Bluff, Sacramento, Santa Monica and San Diego, Cal., Las Vegas, Nevada, and Holbrook, Arizona.

The illustrations of the New England States appearing in this number were taken on previous and subsequent flights.

Lieutenant Stevens and Lieutenant Macready flew from Dayton, Ohio, to Washington, D. C., with the photographs reproduced in this GEOGRAPHIC, together with Lieutenant Macready's manuscript of his non-stop flight.

GREATER NEW YORK BY NIGHT

One of the most vivid impressions gained by the two aviators was one which, unfortunately, cannot be effectively transmitted to a photographic plate—a great city by night. Speaking of their experience in flying over New York, Brooklyn, and Jersey City, Stevens and Macready say:

"We come up the harbor at an altitude of a thousand feet or more; we may well imagine we are in another Eiffel Tower,

Official Photograph, U. S. Army Air Service

EQUIPMENT USED IN MAKING THE WORLD'S RECORD HIGH ALTITUDE PHOTOGRAPH

Lieutenant Stevens, the photographer who made the remarkable airplane pictures illustrating this number of THE GEOGRAPHIC, is seen wearing the oxygen mask which he used on his flight resulting in the photograph taken from an elevation of six miles, reproduced on page 84. On his left is the new K-3 high altitude camera and at his right the oxygen tank used by aviators at high elevations.

with the advantage that we can carry the tower wherever we will. Below is the Statue of Liberty, with its circle of flood lights around the base and the great torch gleaming above. Ahead, on the left, are the lights of Jersey City, row on row, as far as the eye can see; on the right are the lights of Brooklyn and Long Island, a radiance bounded only by the waters of the Atlantic, and directly in front, glowing like a city that has burned and from which the smoke has risen, leaving only the red hot embers, is Manhattan.

"It is 6 o'clock, in December; the work hours are over for the office forces, but janitors are busy cleaning up and the huge skyscrapers gleam with light from top to bottom. The illumination is so strong that the skeleton structures disappear and the buildings seem to be mammoth white-hot cinders, slowly to crumple and collapse.

"As we pass along, the panorama of New York's streets unfolds; Broadway becomes more and more brilliant, until a nucleus of light appears at the theater district, where hundreds of electric signs turn night into day.

"We know that the North River is under us, but we cannot tell by looking; so many craft, carrying lights, dot its surface, that there is no distinct break; we cannot tell where the shorelines are.

"We turn to the right, pass over Central Park, at two thousand feet or more, cross the East River and proceed down Long Island to the landing field, where the sound of our engine is a signal to turn on flood lights.

"We come down in long spirals in the blackness, until the radium dial on our altimeter shows a few hundred feet only and we are at the proper gliding distance. We float in, closer and closer; we are nearly over the center of the field. Suddenly the ground appears out of the dark; we flatten out and in a moment the tail skid and wheels touch and we roll to a stop."

In the course of their grand circuit of the forty-eight States, Stevens and Macready had occasion to land at Las Vegas, Nevada, and Stevens records this bit of biography concerning his confrère:

"The citizens of Las Vegas apparently gave him little credit for being a well-known aviator, but greeted him as the former Justice of the Peace of the Searchlight Bench and Bar, and a one-time miner and cattleman. Searchlight, it may be mentioned, is a small Nevada town, 70 miles south, which, in the old

Official Photograph, U. S. Army Air Service

"ABOVE THE THREE-MILE LIMIT"

"Upon reaching the landing field outside of Boise, Idaho, we were greeted by friends with a bucket of cracked ice and something that looked like beer. It proved to be only the one-half of one per cent variety. Our pictures were taken with the bottles upturned to the sky, and later appeared in the evening paper with the caption, 'Above the Three-Mile Limit.'"—*Stevens and Macready.*

boom days, included thirteen saloons and two grocery stores.

"From the age of thirteen until graduation from college, Macready had spent his vacations on the desert and in the mines and was the amateur lightweight boxing champion of the Pacific coast for three years; then he entered business in Searchlight, where for four years he held the scales of Justice, performed marriages, and disposed of the dead in characteristic brief frontier fashion. 'Stand up, join hands—you are married; fee is $2.50'—a bit shorter than the usual ceremony, but it legally filled the bill, even though the Justice of the Peace was still in his twenties!"

EXPEDITION ORGANIZED TO PHOTOGRAPH SOLAR ECLIPSE

The Stevens-Macready survey of the entire United States was a by-product of official orders to photograph the solar eclipse in the vicinity of San Diego on September 10, 1923, and, although weather conditions made it impossible to obtain the photographs hoped for, the experience as described by the aviators is one of the most graphic chapters in the history of airplane adventure. They have given this description of that flight:

"Between 10 and 11, we left Rockwell Field and skirted the coast just beneath a heavy bank of fog that rolled in from the ocean. Success seemed doubtful. Nothing was visible except the low shoreline on our left and the ocean waves.

"As we approached Ensenada, Mexico, the weather gave promise of improvement; the fog lifted and there were holes in a layer of clouds at 5,000 feet. So the plane rose in a steady climb until we were above the first layer.

"Above us, however, was another layer of clouds, and at 14,000 feet we penetrated the lower limits.

"From now on, as we climbed, there was little to be seen except a wall of white

Official Photograph, U. S. Army Air Service

FIVE SNOW-CLAD PEAKS IN ONE PHOTOGRAPH

In the foreground is Mount Jefferson (10,522 feet) 25 miles away, with Olallie Butte (7,243 feet), to the right, just beyond. In the middle distance is Mount Hood (11,253 feet), 72 miles away. In the distance on the right is Mount Adams, in Washington (12,326 feet), 130 miles away. Far to the left is Mount St. Helens (9,697 feet), 135 miles away, and in the center, in the extreme distance, is Mount Rainier (14,408 feet), *175 miles away*. The view is made looking directly north, from an elevation of 12,000 feet, from a position over Mount Washington, Oregon, just north of Three Sisters Mountains.

XUM

Official Photograph, U. S. Army Air Service

THIS PHOTOGRAPH SHOWS THE DIFFICULTY OF JUDGING THE ELEVATION OF A PEAK IF THE HORIZON BE NOT CLEARLY DEFINED BEYOND IT

In the lower right corner is a cloud through which the airplane is just passing; this cloud is equal in elevation to those shown over the peak. The airplane is therefore above the peak, though from first glance at the photograph one would say that the peak towers above the machine.

Official Photograph, U. S. Army Air Service

THE NORTHERN SLOPES OF MOUNT HOOD, SHOWING, FROM LEFT TO RIGHT, ELIOT, COE, LADD, SANDY, AND REID GLACIERS

Floating from the summit is the hood cloud from which the mountain gets its name (see also page 51). In strong winds the pressure to the leeward of the peak is more or less reduced, and the resulting low temperature, intensified, perhaps, by the cold mountain surfaces, brings moisture in the air to below the dew point, and creates this singular cloud that, though continuously evaporating, as constantly reforms.

Official Photograph, U. S. Army Air Service

LOOKING DOWN UPON BROTHER AIRMEN NESTLED ABOUT THE BASE OF THE WASHINGTON MONUMENT

Having completed their photographic survey of the United States, Lieutenant Stevens and Lieutenant Macready flew from Dayton, Ohio, to Washington, bringing to THE GEOGRAPHIC their pictures and notes (see text, page 85).

Official Photograph, U. S. Army Air Service

EQUIPPED FOR A HAZARDOUS FLIGHT

On the left is Lieutenant James Doolittle, U. S. A., who made a one-stop flight across the continent. On the right is Lieutenant Wendell H. Brookley, pilot at McCook Field, famous for his spectacular "stunt" flying. Parachutes have saved many aviators' lives within the last few years. Lieutenant A. W. Stevens, U. S. A., the famous aërial photographer, in June, 1922, established a world's record at McCook Field, when he jumped from a height of 24,200 feet, or nearly five miles (see text, page 85).

in every direction. It was a considerable strain to guide two tons of metal and fabric on even keel, at a speed of a hundred miles an hour, for minutes at a time through continuous masses of clouds.

"Rain began to drench our goggles and to run back over the wing surfaces. The plane was struggling to better its elevation of 16,000 feet and get above the clouds, but while we were still trying to fix it, the eclipse took place.

"For some minutes the light had been waning, and suddenly we felt, rather than saw, the leading edge of the moon's shadow whisked over us.

"Outside the fuselage long blue flames writhed from our exhaust pipes; it was like a flight at night in every way except one—there was a horizontal color band wherever we looked. To the northwest this band was a wonderful red and orange; to the southeast it was white.

"As the shadows passed on the band became rose color in all directions, and after a few moments the northwest became white while the southeast became red; then, as suddenly as it came, the shadow whisked by us."

So, while this unique undertaking of Stevens and Macready failed in its primary object because of weather conditions, the collection of unrivaled photographs of America has enriched mankind's knowledge of "The Land of the Best." Theirs has been a distinct geographic achievement.

The pictures reproduced in this GEOGRAPHIC reveal the globe on which we live in a new aspect. All of them warrant not mere passing notice, but will repay long and careful study, for each has features which are not apparent to the hasty glance.

MAN'S AMAZING PROGRESS IN CONQUERING THE AIR

By J. R. Hildebrand

Author of "The Geography of Games," "The Sources of Washington's Charm," etc., in the National Geographic Magazine

MAN never before achieved such rapid progress in any engineering problem as he has attained in his conquest of the air.

Since classic times he has dreamed of exploring the new world of the air; for centuries he tried to add a third dimension to his travels.

It was not until September, 1908, that Orville Wright's biplane rumbled down a creaky launching rail that looked like a chute-the-chute at a county fair, wobbled a bit in the air, and cruised around Fort Myer, Virginia, for 57½ minutes.

Within fifteen years the Navy's *NC-4* crossed the Atlantic in the air,* an Army air squadron flew from New York to Alaska,† two Army birdmen spanned the continent by a non-stop flight from New York to San Diego (see pages 1 to 83), and our air mail planes had delivered letters in New York 26 hours and 11 minutes after they were postmarked in San Francisco.

In the past year or so aviation progress has been accelerated at an astounding rate. Of all the noteworthy records which airmen had set up by the New Year of 1923—records for speed, endurance, distance, altitude, and load-carrying—practically every one had been surpassed by the dawn of 1924; and of the 55 recognized airplane and airship records as they stood on June 1, 1924, the United States holds 41.

TRAVEL FASTER, FARTHER, AND HIGHER

In the golden flying year of 1923 a Navy aviator set a new dizzy speed mark of nearly 267 miles an hour, a faster pace than man had ever traveled; a Frenchman ascended a mile higher than Mount Everest's unscaled summit, farther skyward than man had ever climbed; and two American military aviators made a new duration mark of more than 36 hours (see page 49), longer than man had remained aloft before.

Not only new records, but new instruments and methods of the past 18 months blazed the path for future achievements which were but vague hopes a few years ago.

The American Navy successfully operated the largest craft that now plies in air, the *Shenandoah*, and it evolved a "vest pocket" and "folding" airplane for use with submarines (see page 111).

Our military establishments perfected the aërial torpedo, rendering then existing battleship designs archaic; developed smoke screens, great sky-hung curtains to conceal their dramatic attacks; and refueled planes while they shot through the air at speeds which outdistance our fastest express trains (see text, page 121).

In March, 1924, a modest newspaper notice told how two Army aviators flew from Dayton to Mineola without seeing ground for 450 miles of the 575-mile trip. That flight was epochal, for it marked the successful testing of the earth-inductor compass, the turn indicator, and the inclinometer, instruments which will enable the aviator to navigate amid the fog or above the clouds, independent of railroad, river, or highway landmarks.

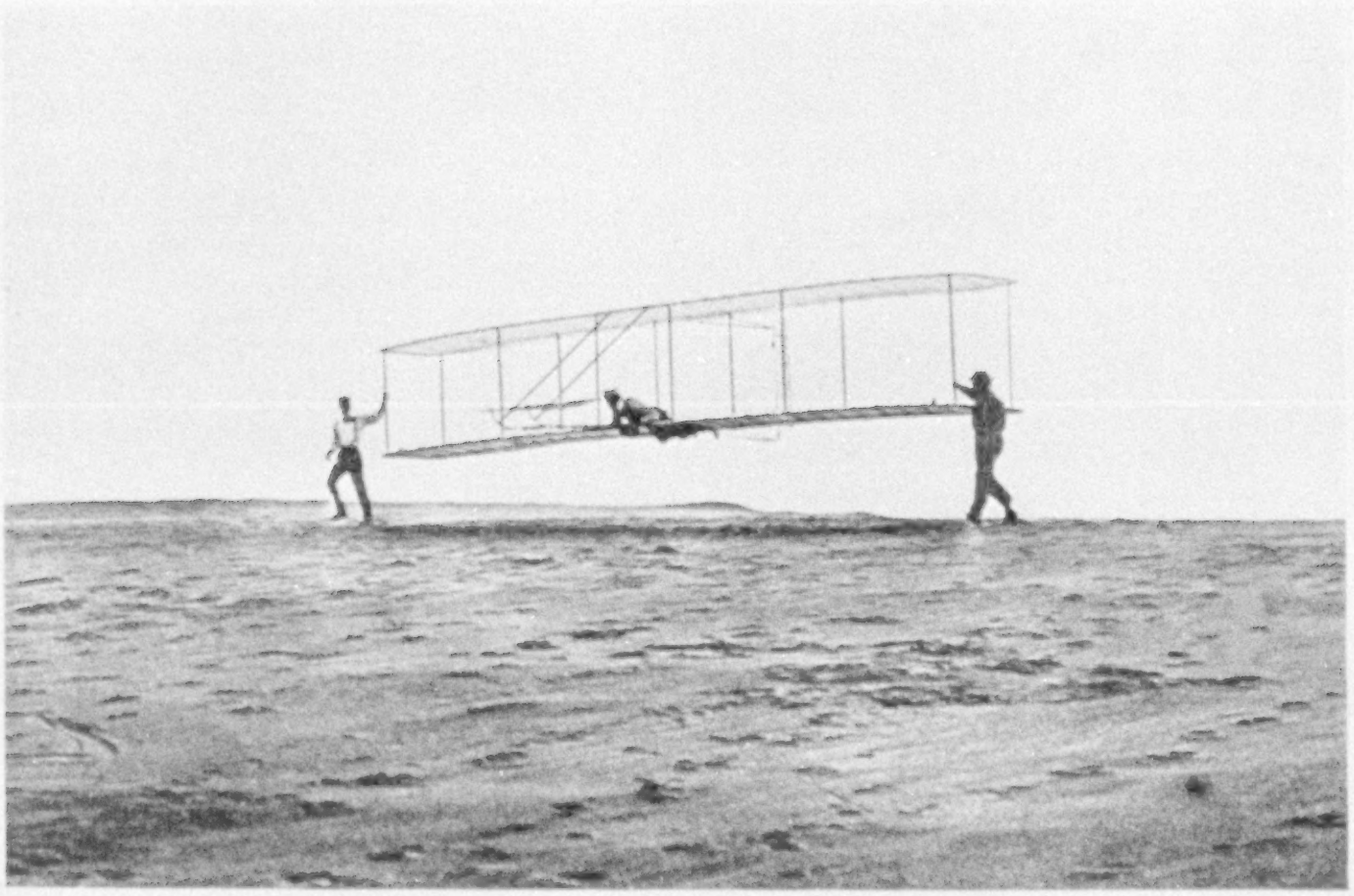
Those three inventions, in conjunction with the radio and the process of refueling in the air, promise to cut the airman's last mundane fetter and literally give him complete freedom of the air so long as his plane and engine remain intact.

HELIUM MAKES AIRSHIP A FLYING FACTOR

The rigid airship being developed by the Navy, of which the *Shenandoah*, acquired in 1923, is a type, bids fair to rival the airplane in providing the public with

* See "The Azores, Picturesque and Historic Half-Way House of American Transatlantic Aviators," by Arminius T. Haeberle, in The Geographic for June, 1919.

† See "The First Alaskan Air Expedition," by Capt. St. Clair Streett, in The Geographic for May, 1922.



Official Photograph, U. S. Army Air Service

THE WRIGHT GLIDER AT KITTY HAWK, NORTH CAROLINA, IN 1902

When the Peace Treaty prohibited the Germans from further airplane manufacture, they turned to devising gliders. These were acclaimed as novelties, but they were not new. The Wrights used gliders to learn the fundamentals of air navigation before they sought to fly in an engine-propelled machine. The present records for gliders are all held by France, where machines have stayed in the air more than 8 hours, climbed to 1,787 feet, and flown for more than 10½ miles.

vehicles of air travel and parcel delivery. The airship itself is not new—Zeppelins were conspicuous in the World War—but the use of helium for their inflation is an American modification which eliminates the danger of ignition and explosion. And the United States possesses the only known supply source of helium.

The *Shenandoah* owes her life and the lives of her crew to this noninflammable, nonpoisonous gas. If, on her memorable "wild night" of January 16, 1924, she had been inflated with hydrogen, the sparks from the presence of static, which were from 12 to 18 inches long, doubtless would have ignited her gas bags and caused a tragedy.

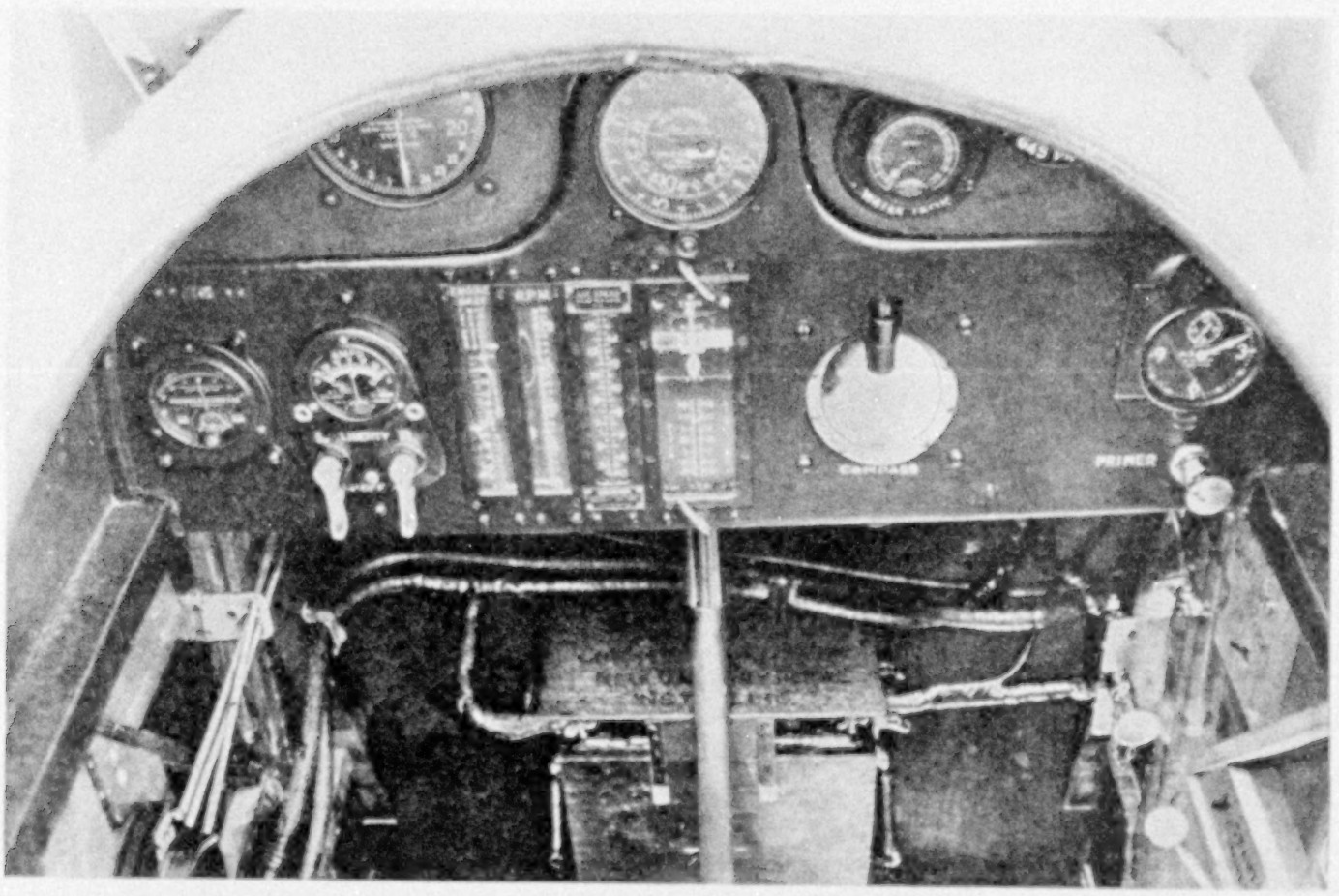
A second adjunct which makes airships practicable is the mooring mast adopted by the British and Americans. The real point to the *Shenandoah's* adventure when she broke loose during a 70-miles-an-hour gale and rode the storm is that the ship did exactly what her crew ordinarily would do for her under similar circumstances (see page 103).

Already America's best-known vehicle is the *Shenandoah*. Hundreds of thousands have seen some of the country's "crack" trains and giant ocean liners; literally millions have watched the silvery *Shenandoah* steal silently across the sky.

This airship comprises many wonder stories of modern science. Its length, 680 feet, is two-thirds that of the *Leviathan*, yet its weight of only 37 tons is a tiny fraction of the *Leviathan's* 50,000 tons.

To house it and a bigger sister ship to come, a hangar was built in a clearing of the New Jersey woods, which building is 201 feet longer than the U. S. Capitol building, just two feet less than the Capitol's widest part, and more than two-thirds as high. The sliding doors at one end weigh 1,300 tons!

As the airship floats mysteriously overhead, it looks like a magnified cigar, wrapped in tin foil, with six tiny baskets



Official Photograph, U. S. Army Air Service

THE LATEST AIRPLANE DASHBOARD WOULD MAKE A MOTORIST DIZZY

While invention yearly is making flying more of an exact science, yet the aviator to-day needs a sixth sense to keep track of his various information-recording devices. His instruments register his altitude, his direction, his speed in reference both to the air and the ground, the rate at which he climbs, and indicate how fast he turns. Various types of thermometers must be watched; he may wish to know how fast his propeller revolves, while a pressure gauge, gasoline gauge, and a flow meter give him news of his engine.

suspended from it. Inside the covering are 20 great gas bags, with a total gas capacity equal to the cubic contents of a train of 700 freight cars. These are interspersed with from 40 to 78 gasoline tanks and a complement of one-ton water tanks (see illustration, page 106).

AIRSHIP HAS SPACIOUS CABINS

This equipment is supported by a metal framework which is a veritable maze of girders, struts, and beams; there are 3,000 struts alone in the intricate design.

It is for this metal framework that duralumin is used—an alloy so light and strong that a girder 16 feet long can be balanced on one's little finger, yet if the tips are placed on blocks it will bear the load of eight men sitting upon it.

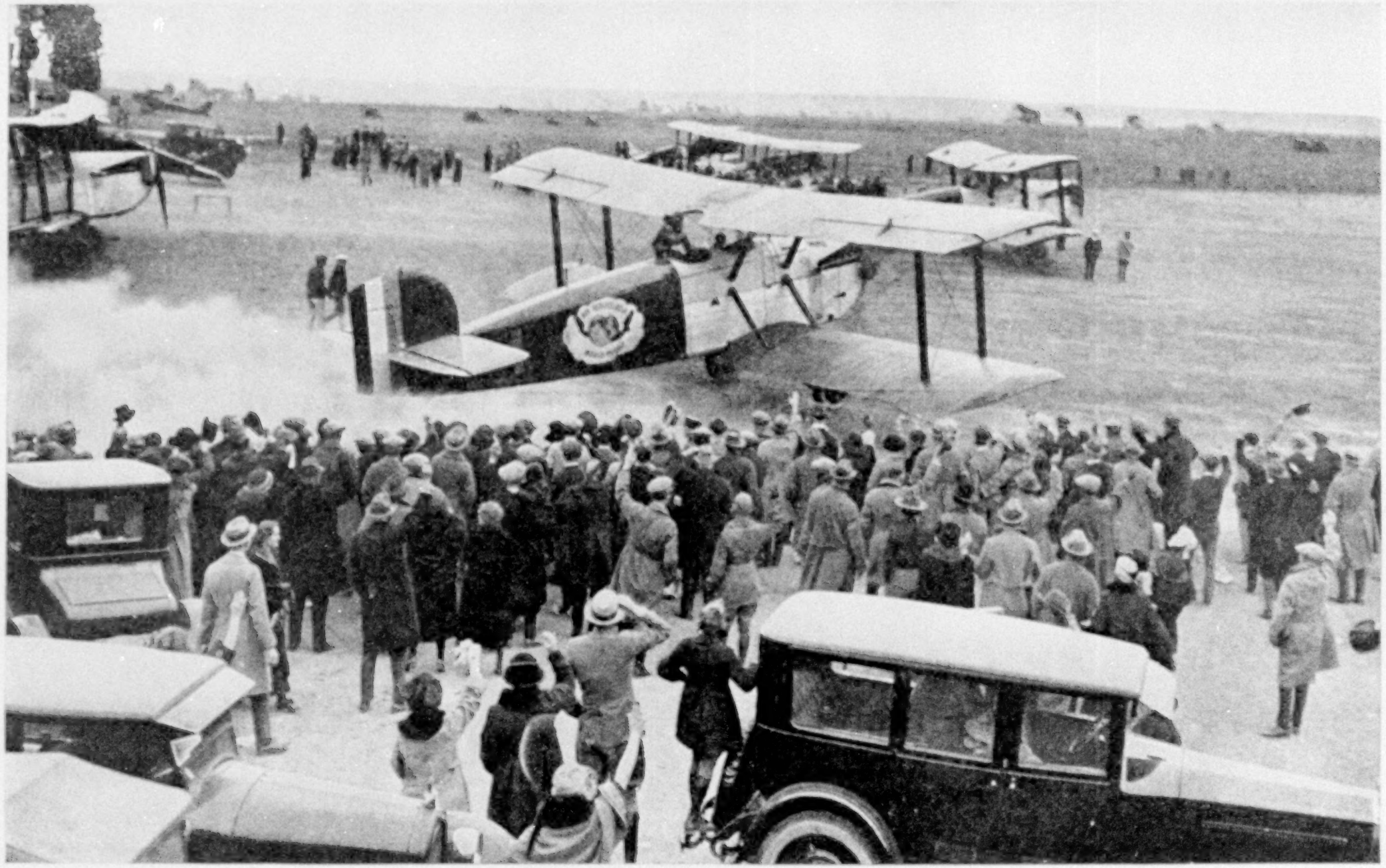
The engines can drive the craft for more than two days and nights at 60 miles an hour, or if the ship slows down to a mere average express-train speed of 50 miles an hour, it can travel for 90 hours.

In one of its six cars is a photographic laboratory, so that motion-picture reels and photographs may be developed on board and the pictorial story of a flight be ready when the ship lands, or even thrown overboard by parachutes at designated places. Another car has a soundproof radio compartment with a powerful sending apparatus and telegraphic instruments.

The airship is the Pullman train of the skies, albeit faster and smoother, providing its passengers with dining-car food, comfortable berths, shelter from the elements, and unrivaled "observation platforms."

CHEMICAL FACT SAVES THOUSANDS OF DOLLARS

The most astonishing mechanical contrivance on the *Shenandoah* is the newly



Wide World Photograph

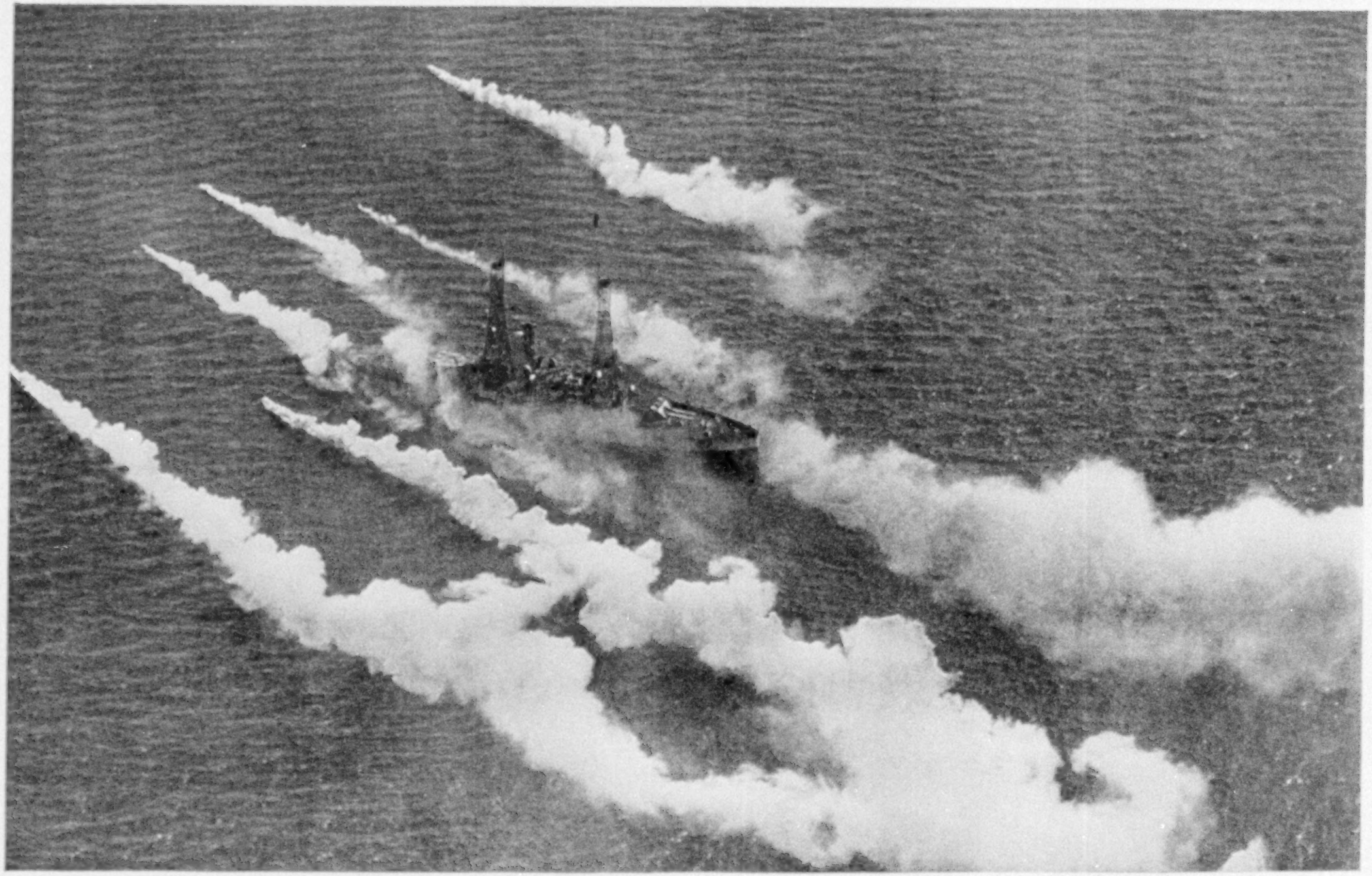
GETTING AWAY FOR ROUND-THE-WORLD FLIGHT FROM SANTA MONICA, CALIFORNIA

This airplane, taking off in command of Major Frederick L. Martin, is one of four U. S. Army planes which started to circle the globe by a 26,000-mile route. The flight is neither a race nor a stunt flight, but a carefully planned test of the possibilities of long-distance air travel. Major Martin's plane was wrecked on the Alaska Peninsula. The squadron of three planes, continuing the voyage, made the first airplane crossing from North America to Asia.

Official Photograph, U. S. Army Air Service

FIRST CONTACT ESTABLISHED BETWEEN AN AIRSHIP AND AN AIRPLANE, IN FLIGHT, AT LANGLEY FIELD, VIRGINIA

By this procedure it is hoped to provide giant airships, of enormous cruising radius, with "messenger planes." The contact is made by means of a trapeze from the airship, which is caught by a sort of grappling hook mounted on the plane. The plane may be carried along when not in use, and refueled to fly away when it is dispatched upon an errand.



Official Photograph, U. S. Navy

A SMOKE-SCREEN CURTAIN FLUNG AROUND A VESSEL BY SEAPLANES

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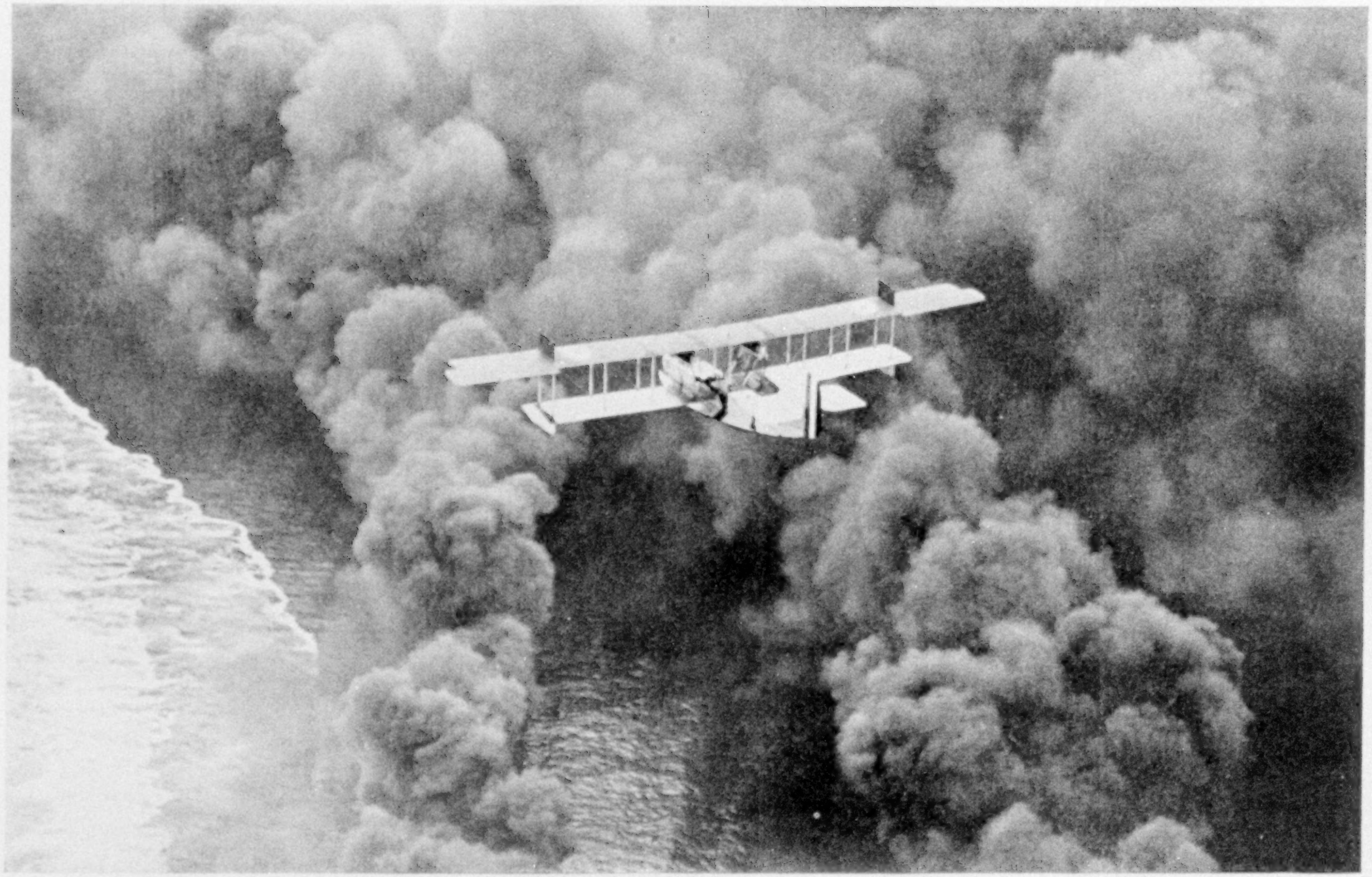
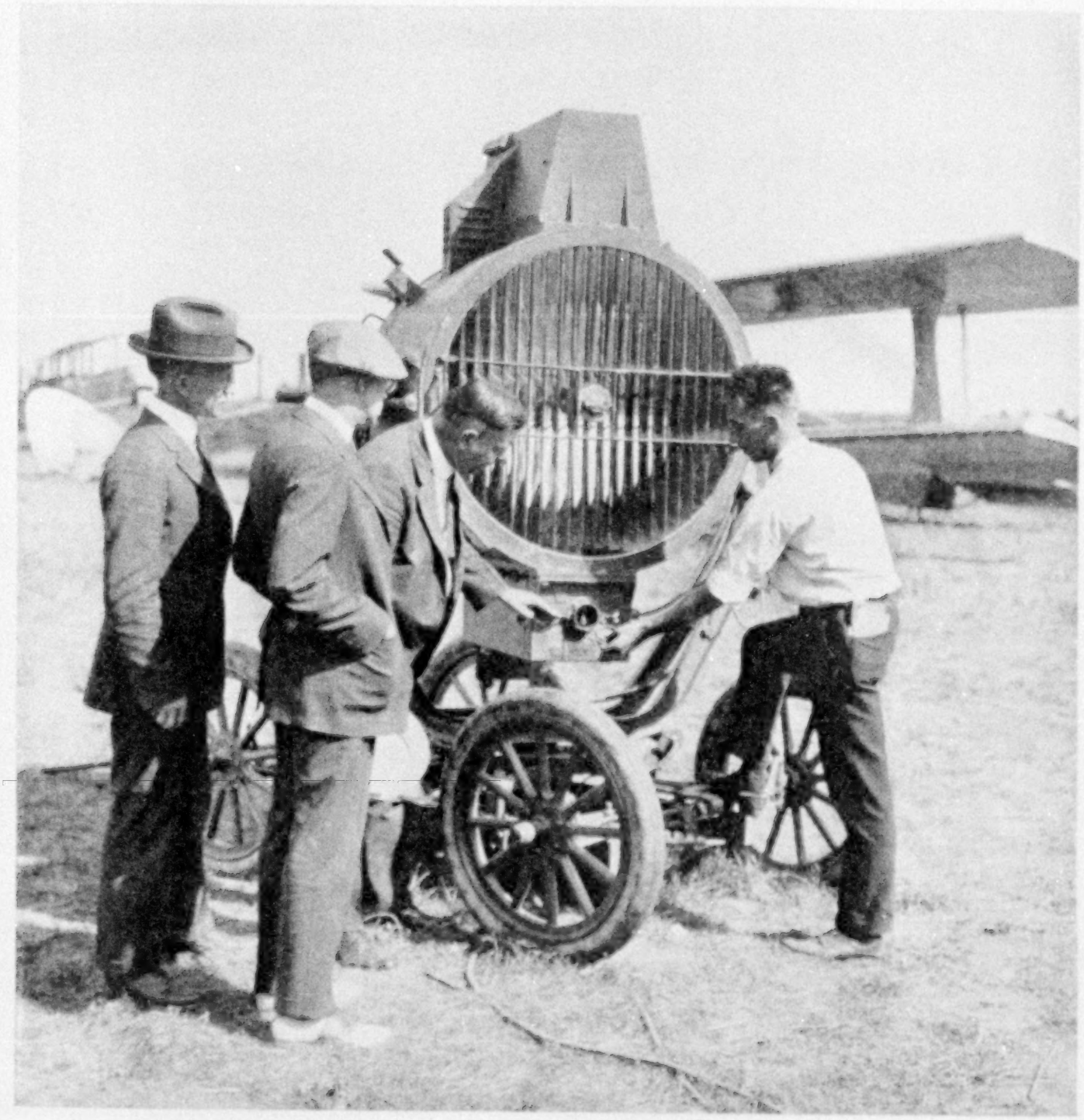


Official Photograph, U. S. Navy

A NAVY SCOUTING PLANE NOSING THROUGH A SMOKE SCREEN



Photograph from Post Office Department

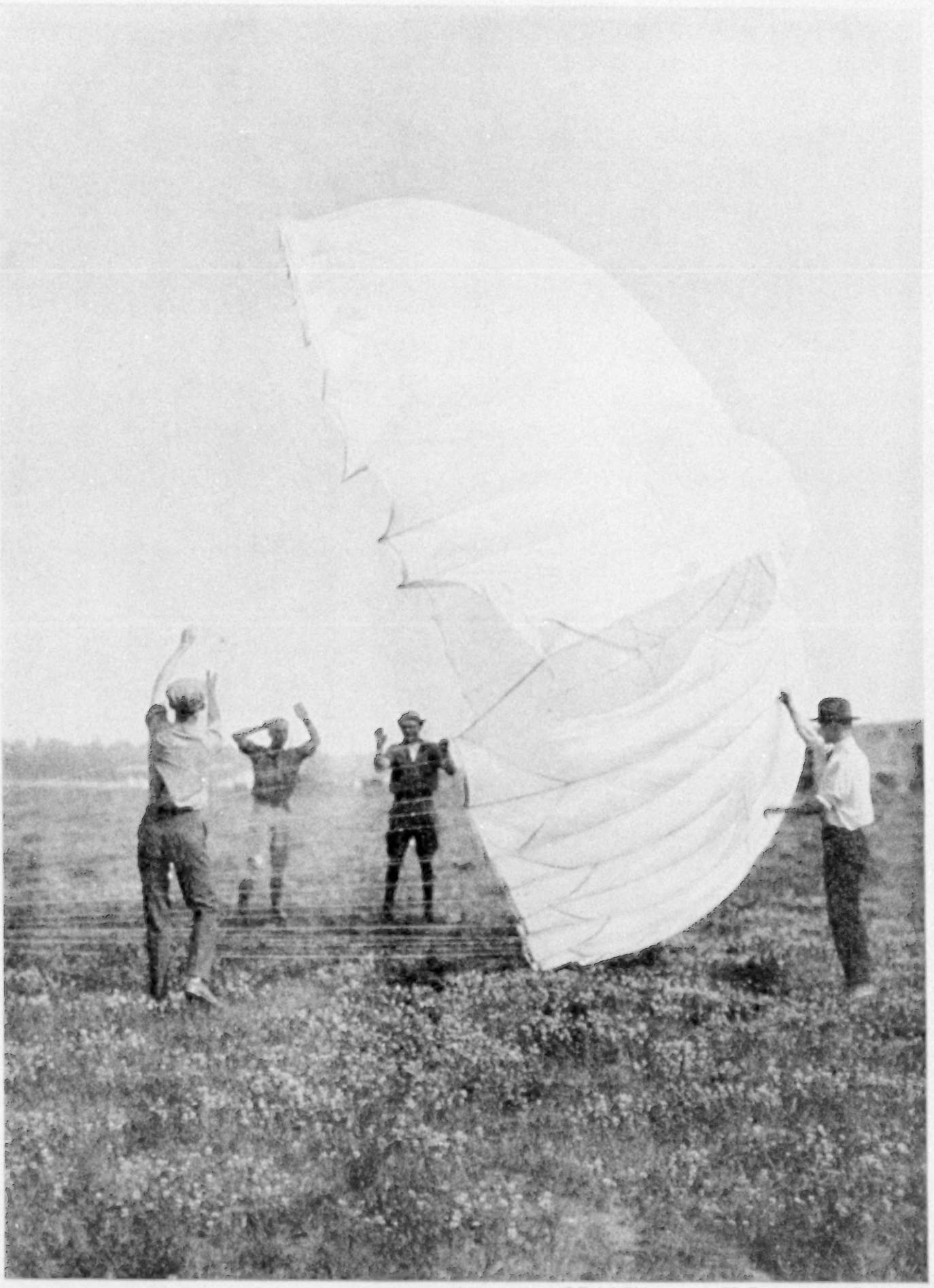
A "MIDNIGHT SUN OF THE AIR MAIL"

The beam of this searchlight has the power of 500,000,000 candles. Five of these beacons will be mounted along the night-flying portion of the transcontinental air route which extends from Chicago to Cheyenne, Wyoming. One will be at each terminal, the other three will be at the major landing fields of Omaha, North Platte, Nebraska, and Iowa City. This light is plainly visible at 100 miles (see text, page 109).

installed water-recovery apparatus, which replaces the gasoline burned with an equivalent weight of water, and thus saves the valving of precious helium.

You will recall, from your chemistry courses, that gasoline consists of hydrogen and carbon. When gasoline is burned, the carbon combines with some of the oxygen from the air to form carbon dioxide, and the hydrogen, with other oxygen, forms water.

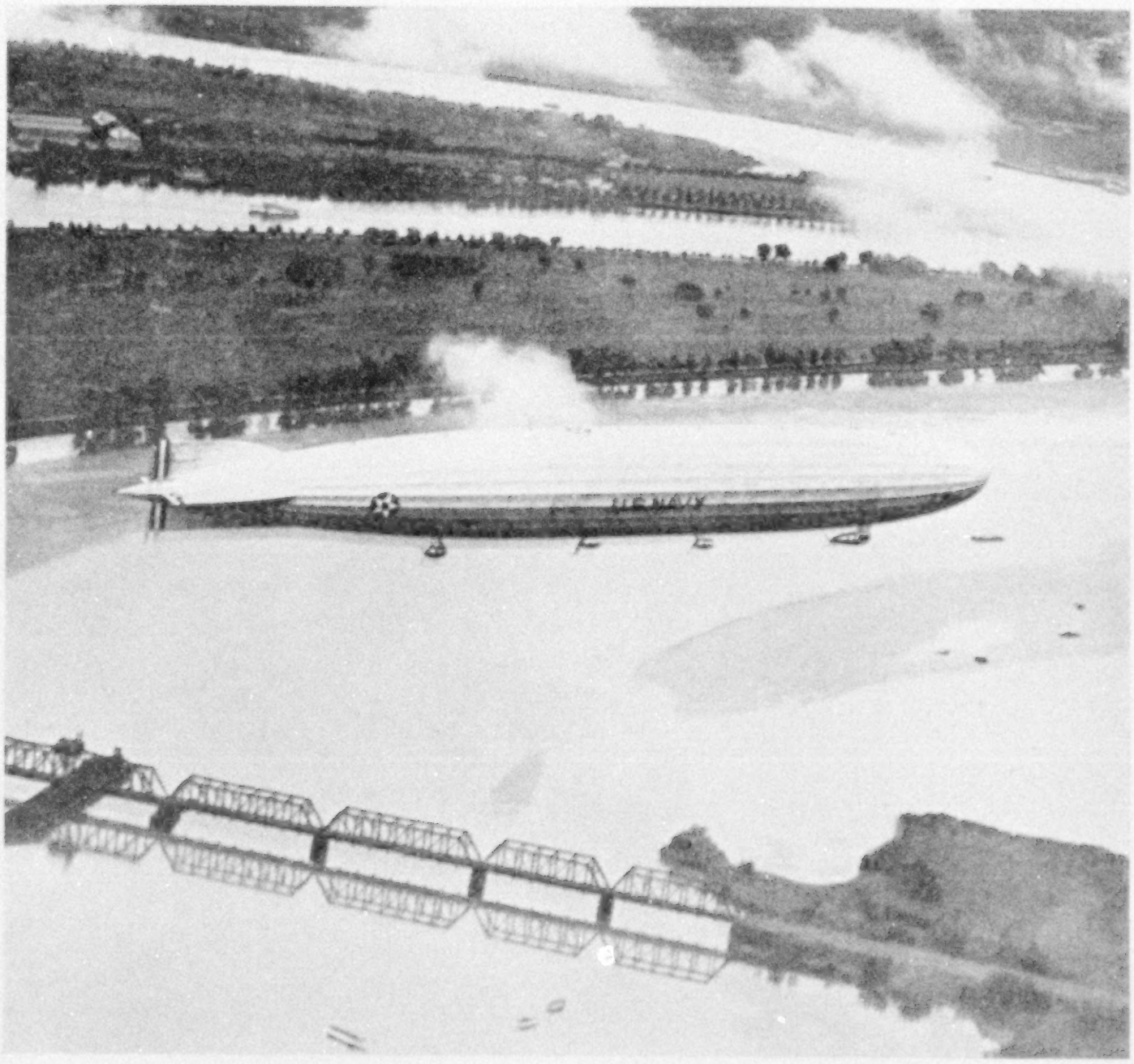
Automobilists notice in cold weather that their exhaust pipes steam. Occasionally the moisture freezes and forms a frostlike ring on the vent. The apparatus for recovering water on the *Shenandoah* consists of several tiers of long, light pipes, exposed to the cooling air, so that the superheated steam condenses and fills water tanks. This manufactured water compensates for the weight of the gasoline consumed.



Official Photograph, U. S. Army Air Service

SEWING A RIP IN A PARACHUTE

Since many high parachute jumps have been impromptu affairs, the distances reported usually are combinations of guesswork and the sort of exaggeration that fishermen are prone to employ. Only in March, 1924, did the International Aëronautic Federation arrange to incorporate parachute jumps among its world-recognized established records (see also page 92).



Official Photograph, U. S. Navy

THE "SHENANDOAH" FLYING OVER THE POTOMAC AT WASHINGTON

In the foreground is Highway Bridge. The longer peninsula, encircled by the Speedway, is a golf course and picnic grounds reclaimed by the U. S. Army Engineer Corps. Near the end of the farther peninsula is the Army War College, here hidden by a cloud, and on the distant shore is Bolling Field, where plans were worked out for the Army's round-the-world flight.

Formerly, as fuel was burned, the ship grew lighter and tended to rise. Thereupon the gas expanded, and it was necessary to release enough helium to equalize the lift of the gas to the weight of the ship.

Even though helium cost has been brought from a radiumlike luxury price to $81 for a thousand cubic feet, the amount the *Shenandoah* had to valve on long trips was an expensive operating item. On its famous St. Louis visit, for example, 200,000 cubic feet of helium had to be valved. The water-recovery device means a saving on one such trip of $16,200—enough to pay for the experimentation and installation of the mechanism.

SHELTERED SCHOOLGIRLS TAKE AIR TRIPS

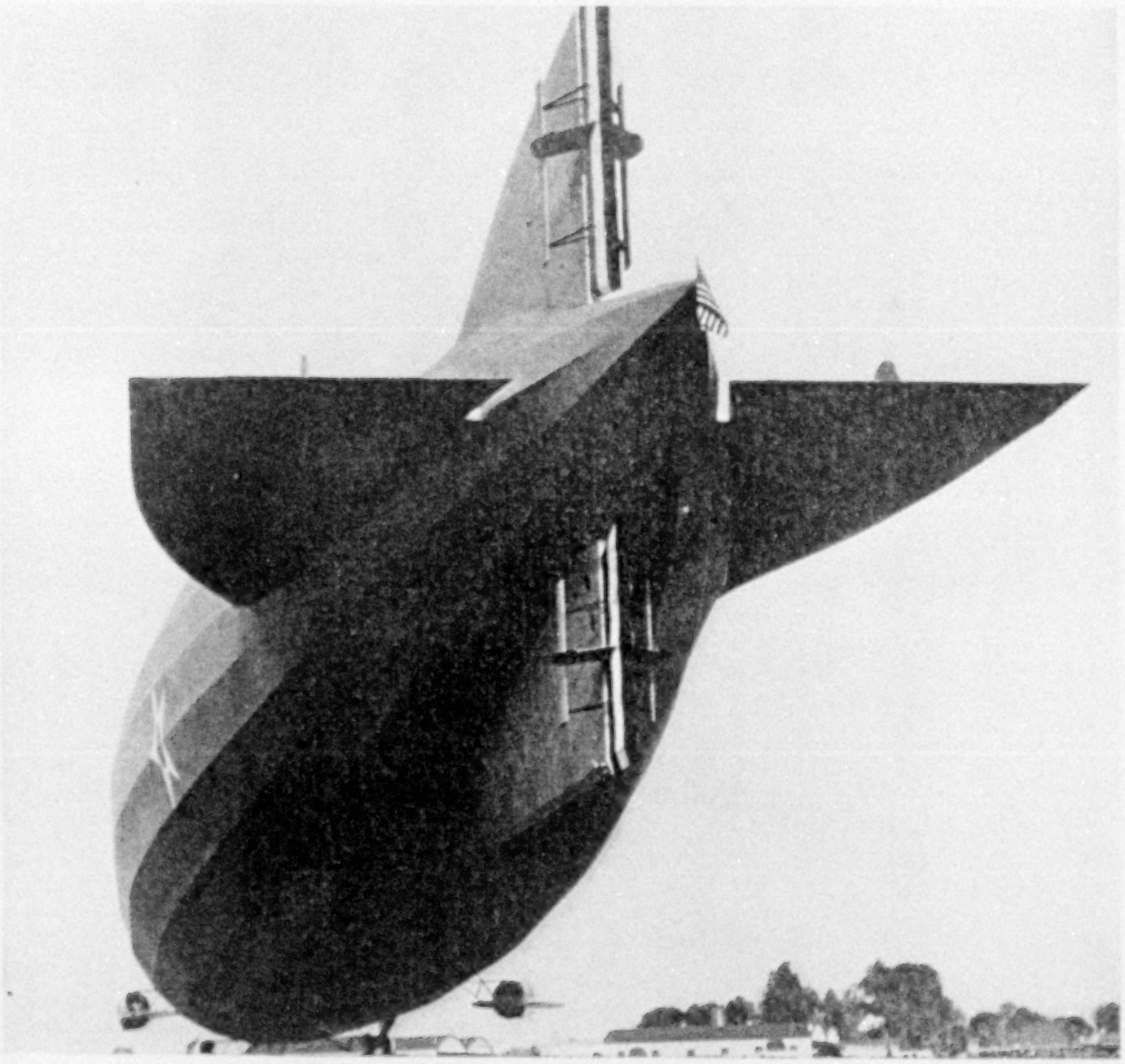
Visitors to Europe know how airplane travel now is taken as a matter of course. In some European cities, where commercial airplane routes are subsidized, the question, "Did you come by air?" attracts no more attention than the American inquiry, "Did you run over by train or motor?" On that continent 10,600 miles of airlines operate on regular schedules.

At many resorts and cities "air taxis"

Official Photograph, U. S. Navy

THE MOORING MAST MAKES THE AIRSHIP PRACTICABLE

The chief difficulty of flying the giant *Shenandoah* at first was getting her in and out of her hangar, an operation which required more than 300 men, and there was always danger of damage. "What will she do at a mast in case of a storm?" is the layman's first question. "Exactly what she would do were she flying," her crew will reply, 'cut loose and ride around it." This was what the ship did of her own accord on her wild night ride of last January.



Official Photograph, U. S. Navy

THE MIGHTY RUDDER AND "FLIPPERS" OF THE "SHENANDOAH"

The rudder controls the direction of the giant airship just as a rudder guides a ship at sea. The "flippers," as the crew calls the horizontal wing-like surfaces, act as do the elevators of a heavier-than-air machine.

await passengers' call. Chaperones of schoolgirl parties include an air trip in their European itineraries

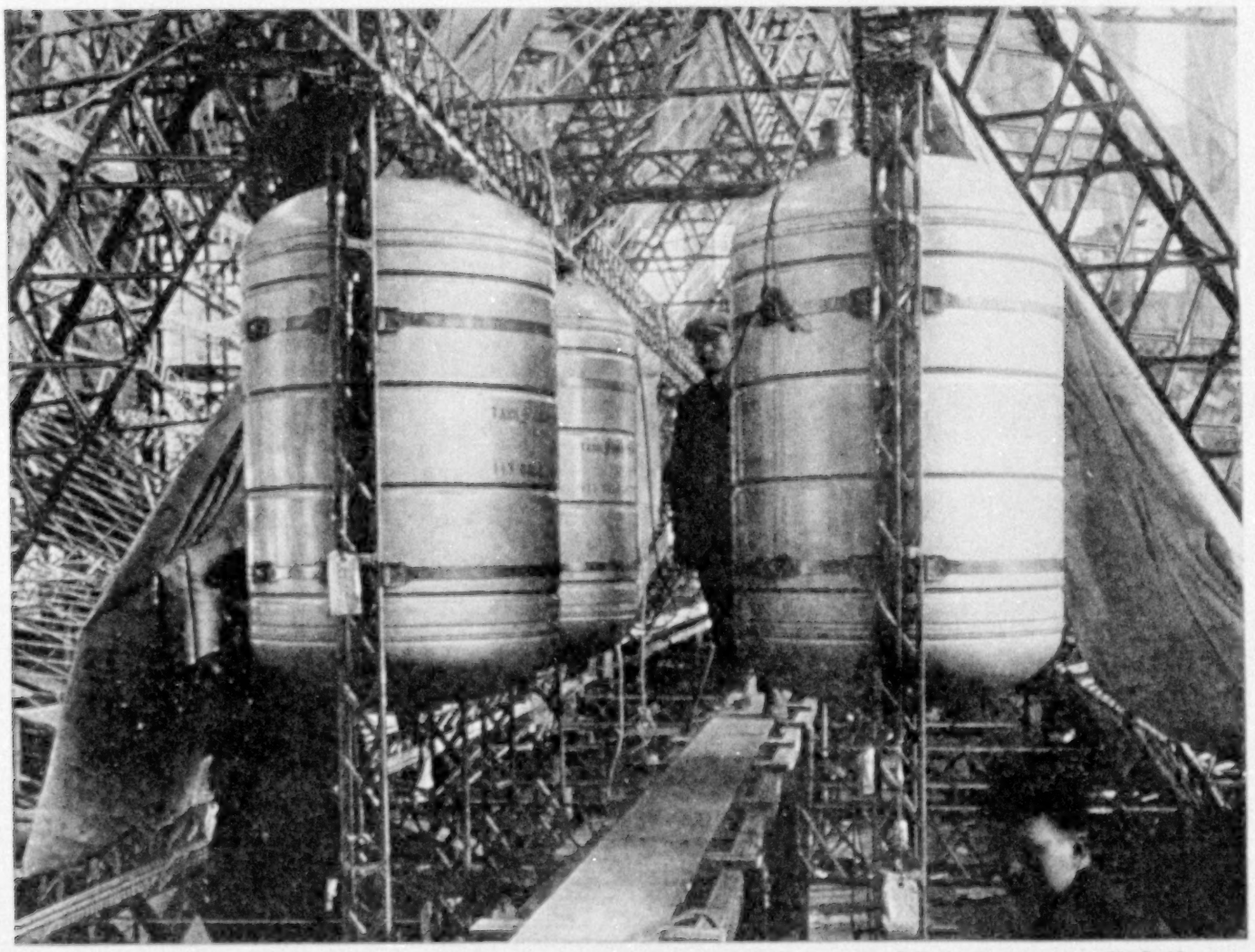
The dependability of the airplane is demonstrated notably in the United States by the air mail route from New York to San Francisco—the longest air service line in continuous operation in the world.

AIR MAILMAN FIGHTS BLIZZARD

In 1922 air mail planes flew nearly 2,000,000 miles without a single loss of life; in 1923 they carried more than sixty-five million letters, traveled more than a million and a half miles, and completed all but 111 of the 7,847 trips attempted.

Thirty minutes out of Salt Lake City last winter an air mail aviator, flying low under the clouds and clearing mountain peaks by 200 feet or so, suddenly plunged into a terrific blizzard. He hadn't a chance to throttle the motor or turn before the wind dashed his machine against a ridge. The landing gear collapsed, the plane slid on its belly over the ridge and stopped.

Stranded at 9,400 feet on an inaccessible peak, the pilot took his compass and his traveling bag and started down the mountain. The ridge had been swept bare of snow, but before he advanced a few hundred yards the snow came up to his waist.



Official Photograph, U. S. Navy

A VISTA OF TANKS AND GIRDERS INSIDE THE "SHENANDOAH"

The simple, cigar-like lines of the huge airship, as she floats silently across the sky, are misleading. Her interior structure is as complicated as that of a battleship (see drawing, page 106). More than 3,000 struts are used in her maze of latticed girders, for which a new material was developed. This metal, an aluminum alloy known as duralumin, has the strength of steel, but only one-third its weight (see text, page 95). Note the "promenade plank" between the rows of gasoline tanks.

With the bag in one hand and a stuffed pair of trousers in the other to support his weight on the snow, the flyer crawled laboriously down the slope through the woods. Frequently pausing to regain his breath and rest his aching muscles, he kept at his task all day and all night, until daybreak brought him to the edge of the woods.

The dread numbness, danger signal of the Arctic explorer, was upon him, but he struggled on to a barn occasionally visible through the driving snow. It was 3 o'clock when he came near enough to the barn to see there was no house adjacent, but he caught sight of one a mile farther on. The storm still raged, the icy wind cut like a razor edge, his strength had nearly ebbed. It was 6 o'clock before he reached the house.

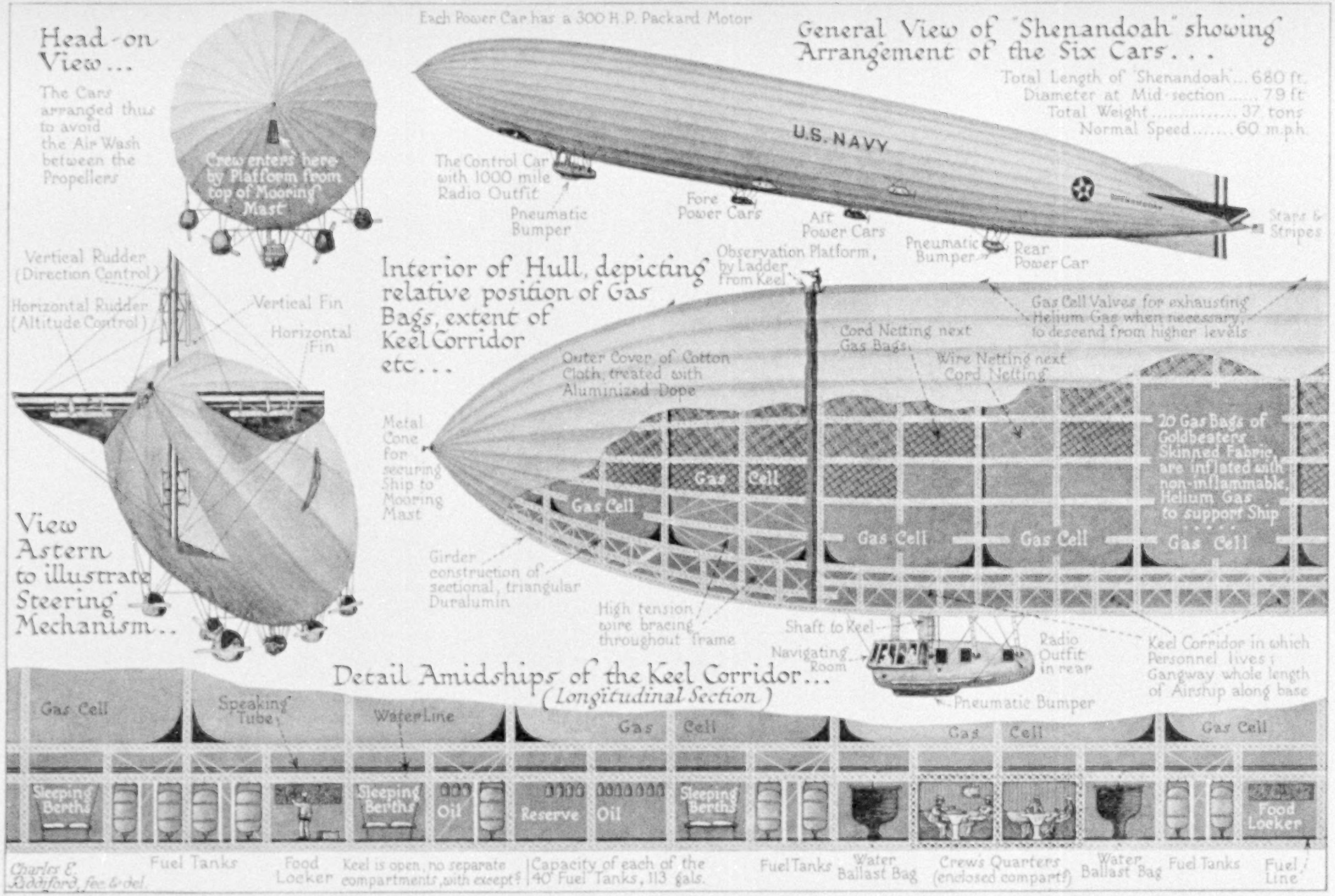
In two days he had recovered sufficiently to ride horseback to the nearest telephone, ten miles away, and there he called up the Salt Lake City post office to say, "I'm sorry I've been lost. Hope you have not been worried about me."

For four days every plane in the Western Division of the Air Mail Service had been searching for him. His plane had been found, but hope had almost been given up of rescuing him.

Another mail airman, leaving Omaha for North Platte, Nebraska, ran into a sleet storm which quickly coated his plane's wires and wings with ice an inch thick. The wires vibrated noisily and two snapped off. The ship became more and more loggy; once it nearly fell into a spin, but the pilot brought it down to an emergency field at Kearney, Nebraska, and forwarded his mail by train.

Then he cracked the ice off the wings and flew on to North Platte.

XUM

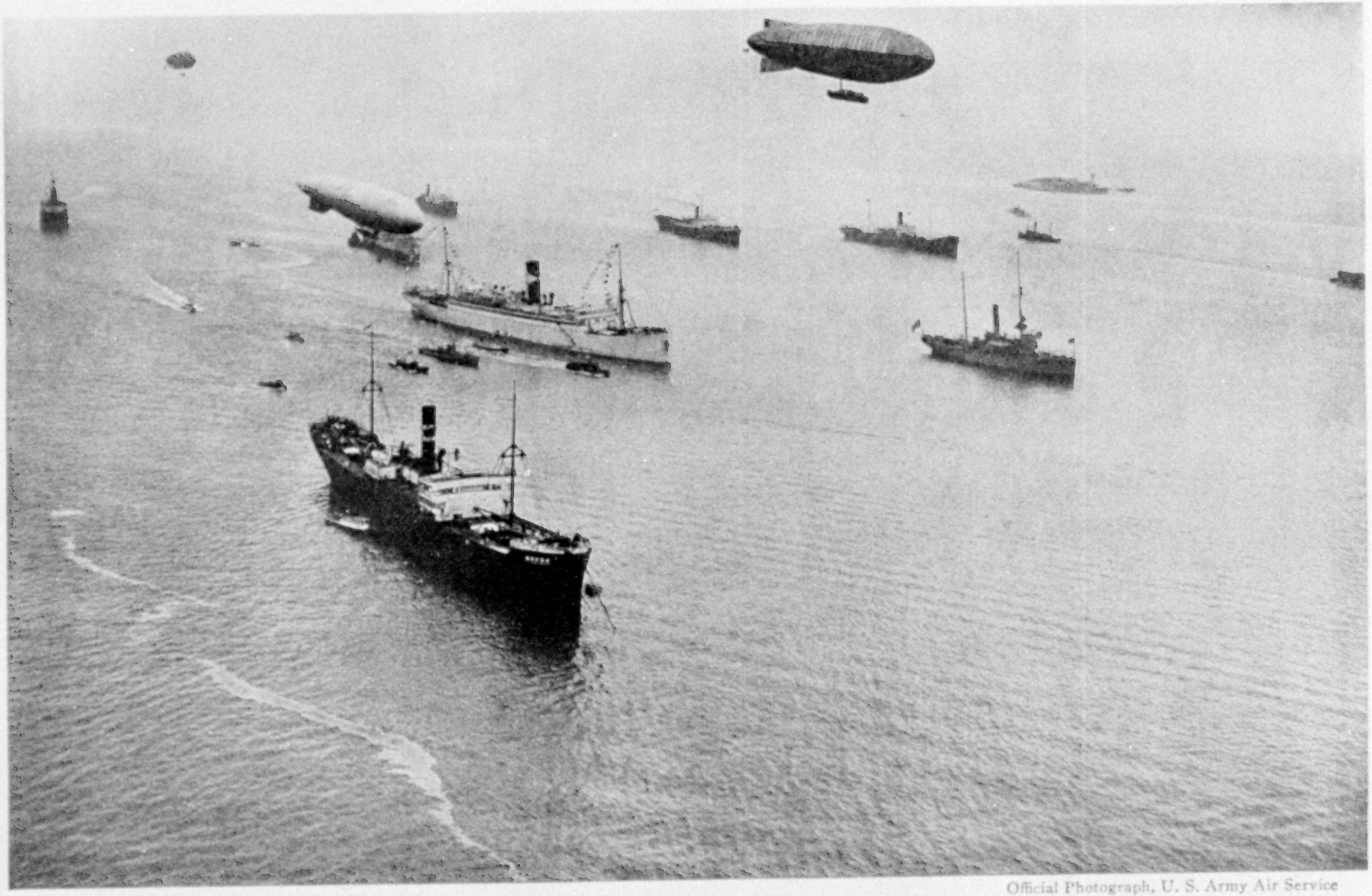

Head-on View...
The Cars arranged thus to avoid the Air Wash between the Propellers
Crew enters here by Platform from top of Mooring Mast
Each Power Car has a 300 H.P. Packard Motor
General View of "Shenandoah" showing Arrangement of the Six Cars...
Total Length of "Shenandoah"....680 ft.
Diameter at Mid-section.....79 ft.
Total Weight.....37 tons
Normal Speed.....60 m.p.h.
U.S. NAVY
The Control Car with 1000 mile Radio Outfit
Pneumatic Bumper
Fore Power Cars
Aft Power Cars
Pneumatic Bumper
Rear Power Car
Stars & Stripes
Observation Platform, by Ladder from Keel
Vertical Rudder (Direction Control)
Horizontal Rudder (Altitude Control)
Vertical Fin
Horizontal Fin
View Astern to illustrate Steering Mechanism...
Interior of Hull, depicting relative position of Gas Bags, extent of Keel Corridor etc...
Gas Cell Valves for exhausting Helium Gas when necessary to descend from higher levels
Cord Netting next Gas Bags
Wire Netting next Cord Netting
Outer Cover of Cotton Cloth, treated with Aluminized Dope
Metal Cone for securing Ship to Mooring Mast
Gas Cell
20 Gas Bags of Goldbeaters Skinned Fabric are inflated with non-inflammable Helium Gas to support Ship
Girder construction of sectional, triangular Duralumin
High tension wire bracing throughout frame
Shaft to Keel
Navigating Room
Radio Outfit in rear
Keel Corridor in which Personnel lives; Gangway whole length of Airship along base
Pneumatic Bumper
Detail Amidships of the Keel Corridor...
(Longitudinal Section)
Speaking Tube
Water Line
Sleeping Berths
Oil
Reserve
Food Locker
Fuel Tanks
Keel is open, no separate compartments, with except?
Capacity of each of the 40 Fuel Tanks, 113 gals.
Water Ballast Bag
Crews Quarters (enclosed compart?)
Fuel Line
Charles E. Lightfoot, fec & del.

© National Geographic Society

CROSS-SECTION AND END-ON DIAGRAMS OF THE "SHENANDOAH"

The silvery appearance of the *Shenandoah's* hull, especially notable the night it floated in stately dignity over the U. S. Capitol dome, with searchlights cutting its cameo outlines against a dark sky, is due to an aluminum powder paint applied to the cotton cover fabric to reflect the sun's rays. This paint was not used for esthetic reasons, but to avoid overheating of the gas bags. A black pigment is spread upon the inside of the cover. Goldbeater's skin, tissue from the intestines of oxen, is used for lining the huge gas bags. Stockyards saved this membrane from some two million cattle for the super *Shenandoah*, the *ZR-3*, soon to be flown from Germany to America.

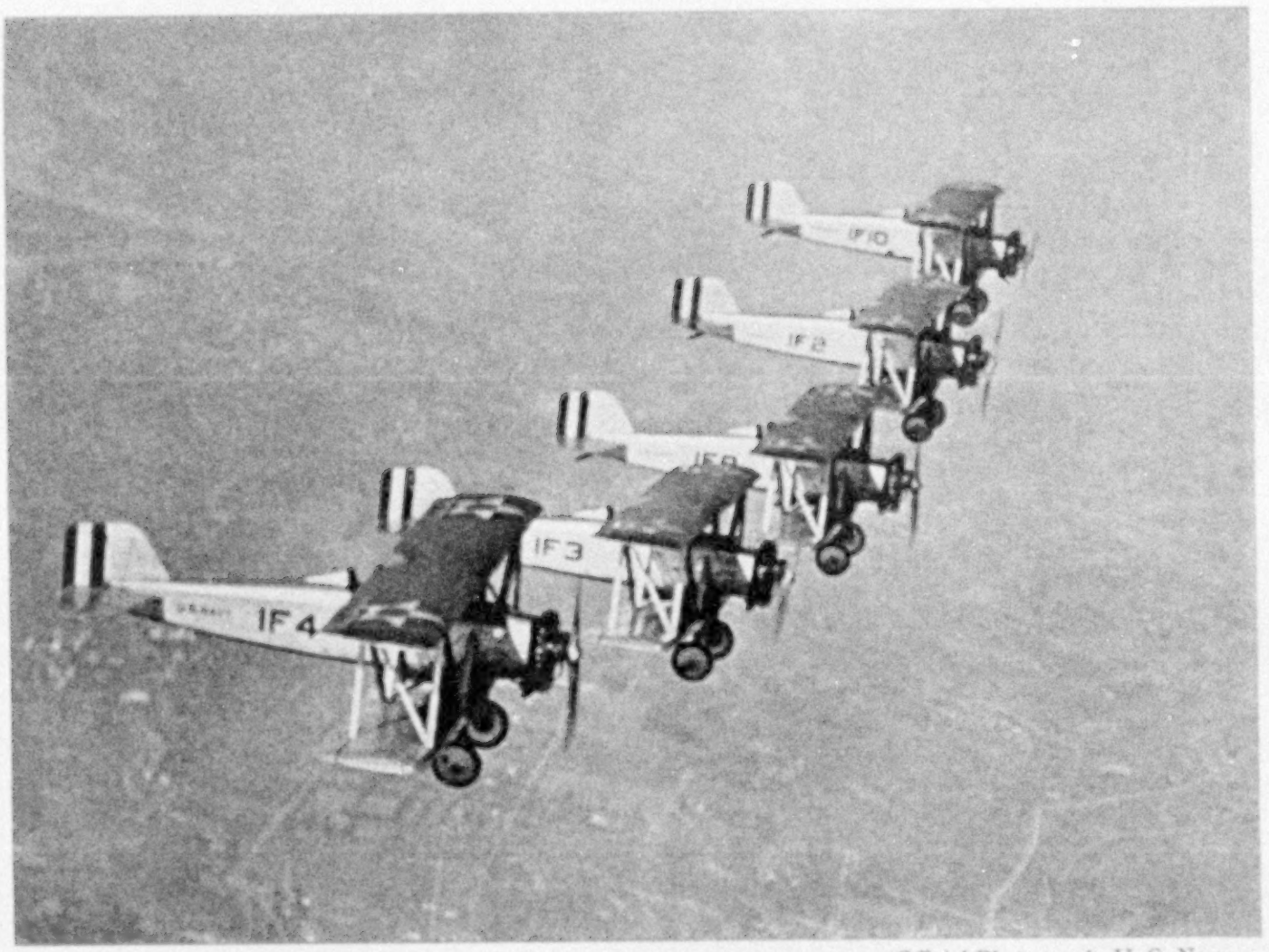
XUM



Official Photograph, U. S. Army Air Service

A PRESIDENTIAL ESCORT OF SHIPS, AIRSHIPS, AND AIRPLANES

The *Pastores,* with Warren G. Harding, then President-elect, steaming into Old Point Comfort, Virginia.



Official Photograph, U. S. Navy

NAVY FIGHTING PLANES IN PRACTICE MANEUVERS

Our Navy has developed widely different types of aircraft for various uses, ranging from the *Shenandoah*, for long-distance scouting, to the bombing and torpedo planes; "spotting" planes, to help control the gunfire of men-of-war, to the fast fighting planes, of which these are types, to clear the air of enemy planes.

Perhaps the most spectacular exploit in air-mail history was that of the pilot whose motor went to pieces 8,000 feet over Unionville, Pennsylvania. Flames burst from the engine and the airman put his plane into a dive, heading for a creek. Smoke blinded him, but he managed to cut off the gas. After diving 5,000 feet the smoke cleared; the dive had blown out the fire. Straightening out, he landed in a field unhurt.

A FLYER'S FAREWELL MESSAGE

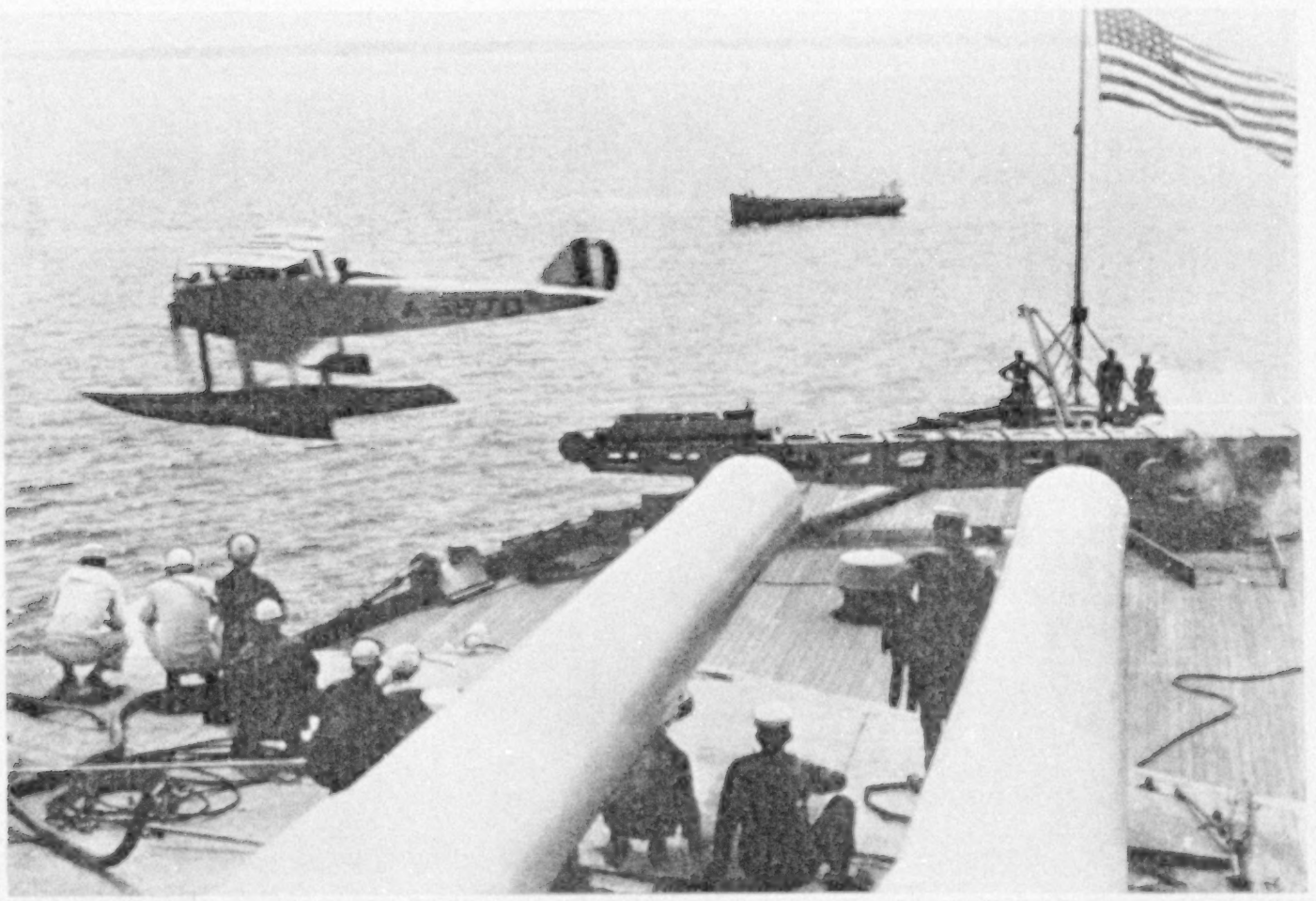
A tragic ending marked the career of Captain Leonard Brooke Hyde-Pearson, air mail pilot and World War flyer, who was killed early in March of this year in the mountains of Pennsylvania. But two letters, addressed to "My Beloved Brother Pilots and Pals" and marked "To be opened only after my death," promise to live as classics of aviation. He wrote:

"I go west, but with a cheerful heart. I hope what small sacrifice I have made may be of use to the cause.

"When we fly we are fools, they say. When we are dead we weren't half-bad fellows. But every one in this wonderful aviation service is doing the world far more good than the public can appreciate. We risk our necks; we give our lives; we perfect a service for the benefit of the world at large. They, mind you, are the ones who call us fools.

"But stick to it, boys. I'm still very much with you all. See you all again."

Hitherto, the operation of the transcontinental air mail has been an "advancing service." For example, planes carried late mail from New York and overtook a Chicago-bound express at Cleveland. Similarly, the 100-mile flights between Seattle and Victoria, British Columbia, and between New Orleans and Pilottown,



Official Photograph, U. S. Navy

A NAVY PLANE LAUNCHED INTO THE AIR FROM A CATAPULT ABOARD THE U. S. BATTLESHIP "NEVADA"

La., are made to take mail off incoming ships or carry late mail to outgoing boats.

On July 1 the Post Office Department begins to carry mail over the entire route from coast to coast in planes. In preparation for this project eight intercoastal relay flights were made last summer, and letters bearing a San Francisco postmark of 6. a. m. August 24 were canceled at the New York Post Office at 2 p. m. the following day.

LAND LIGHTHOUSES FOR MAIL PLANES

It was during these flights that the great white airway along the night route from Chicago to Cheyenne was tested and night flying shown to be practicable. For this achievement the Air Mail Service was awarded the Collier Trophy for the second successive year.

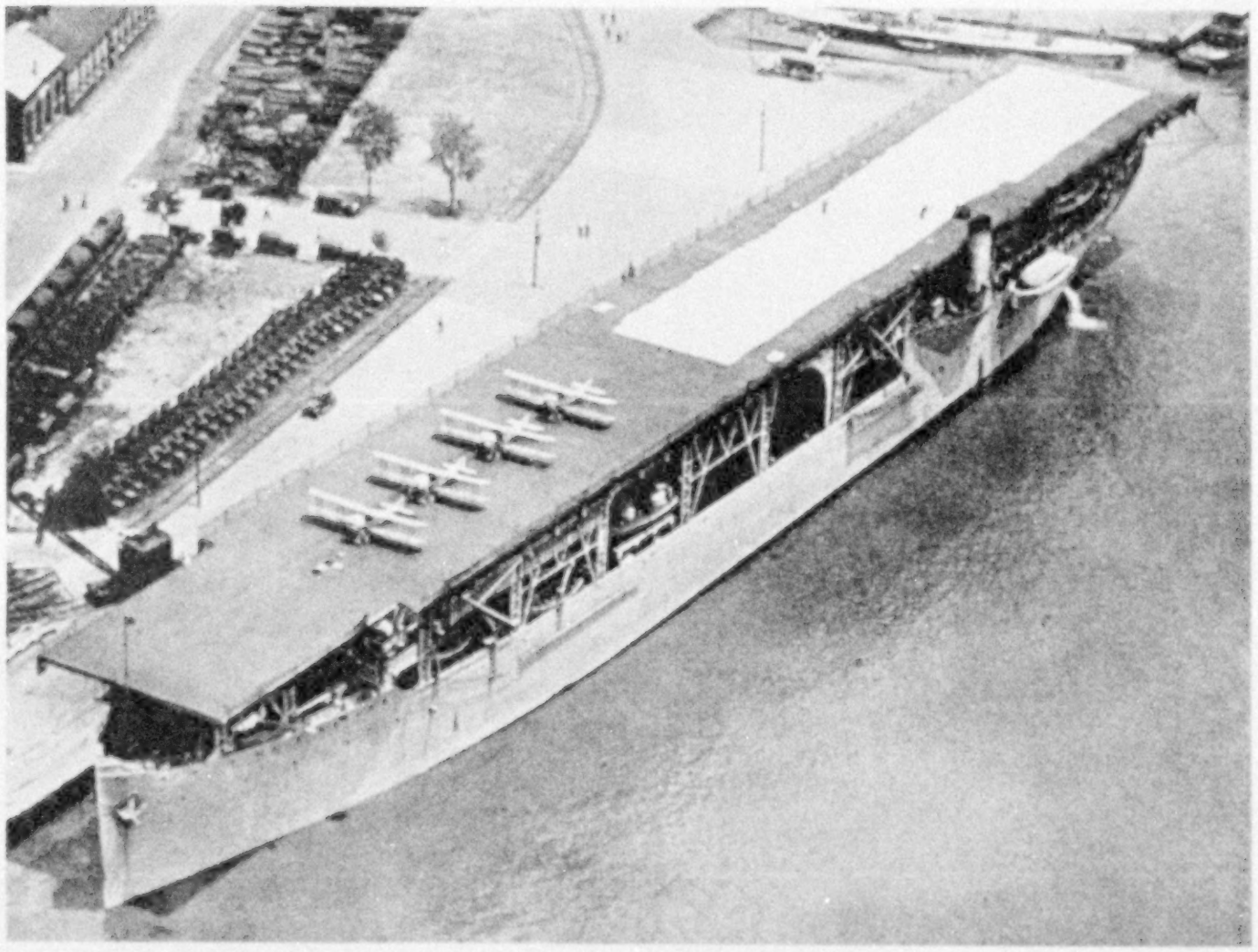
The electrical engineer provided five stations with aërial beacons aptly nicknamed "midnight suns of the Air Mail." Each beacon is a high-intensity arc searchlight, mounted on a 50-foot tower, and it revolves three times a minute.

Set at an angle of one degree, the 500,000,000 candlepower beam from each of these land lighthouses sweeps the sky just above the horizon and has been sighted, on clear nights, at 130 miles. At 100 miles, where it is plainly visible, the diameter of its beam is about two miles.

At 34 emergency landing fields along the night airway, large guiding lights have been installed, and there are smaller light guides every three miles, making a continuous light lane over the 900-mile route.

Numerous mechanical difficulties had to be solved before night flying was practicable. Searchlights are affixed to the wings; the glares of the exhaust must be hidden from the pilot's eyes; and special paint is used on the propeller blades so they will not reflect light.

In addition to the obvious commercial value of speeding up business letters, it has been estimated by a bank official, and, of course, the amount is purely an estimate, that $100,000 has been saved in a single month on the interest on notes which otherwise would have been in mail sacks for two business days between New York and Chicago.



Official Photograph, U. S. Navy

A KEY SHIP OF THE MODERN FLEET, THE U. S. AIRPLANE CARRIER "LANGLEY"

Just as the Army developed refueling (see text, page 121), primarily because land maneuvers may require distance flights, so the Navy, even earlier, devised a way to make seaplanes independent of short landings and capable of going as far seaward as the fleet may go. In 1922 the Navy began to operate the *Langley* as an experimental airplane carrier. To-day planes can land aboard this vessel by means of an arresting device and can take off from her by using a catapult. Operating by compressed air, this catapult accelerates a plane from zero to a 60-miles-an-hour speed, at which rate it is projected into the air (see page 109).

No chariot race, no horse race, no human race, it is safe to say, ever furnished the sensation of seeing an airplane flash by at four miles a minute.

SPEED SPURTS ARE HAIR-RAISING

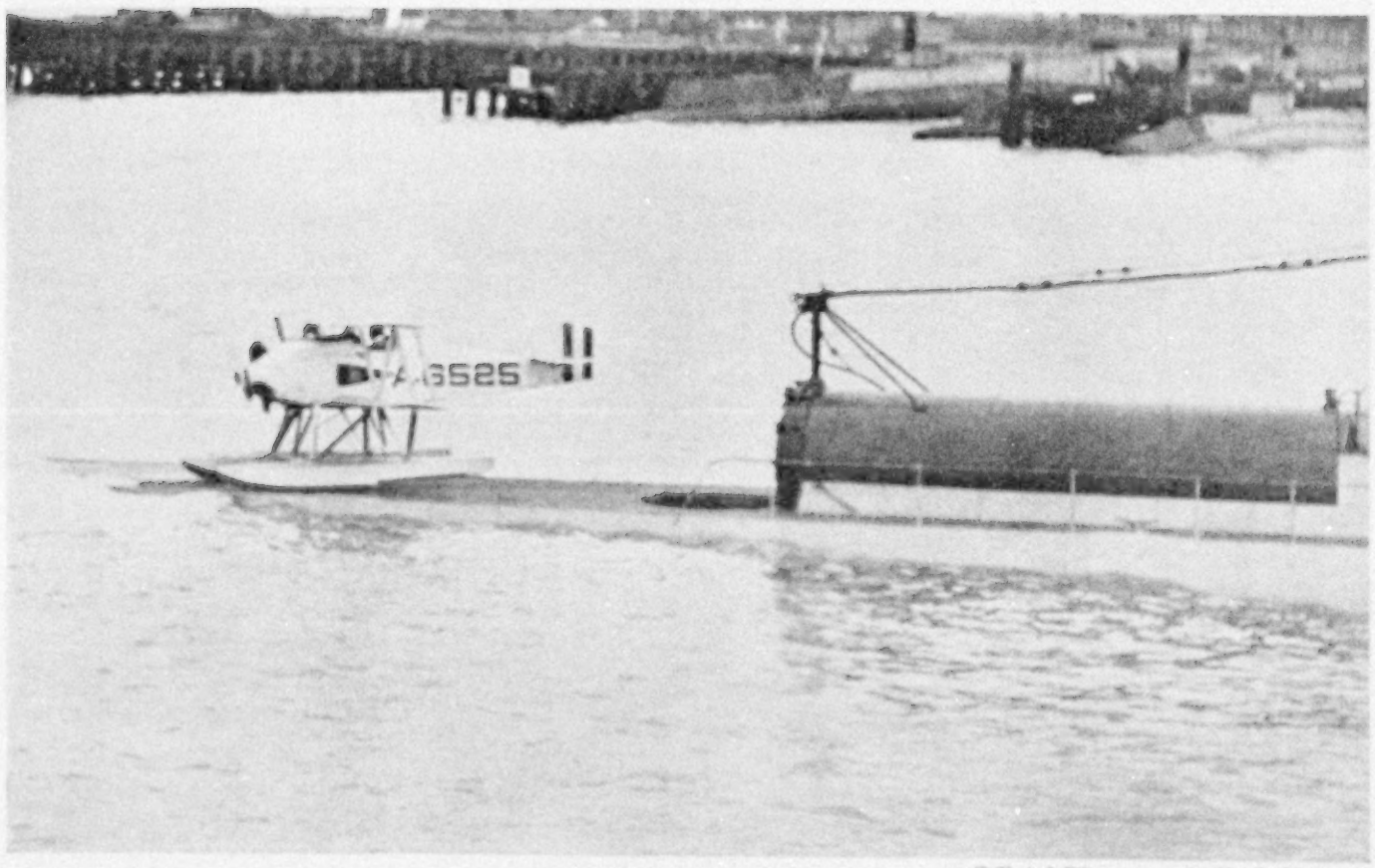
Eighty-five thousand spectators saw A. J. Williams average 243.6 miles an hour when he won the Pulitzer speed classic at St. Louis, and H. J. Brow finish second with a 236.5 mark.

In a speed duel at Mitchel Field to test their planes, Brow reached 274.2 miles an hour and Williams averaged 266 miles for four flights over the prescribed 3-kilometer course. Steel nerves, instant judgment, and utmost precision are demanded of pilots who hurtle through space at such rates.

One of Williams' flights was hair-raising. At 9,000 feet, a mere blotch in the sky, he plunged into a dive that shot him within ten feet of the ground. One-fortieth of a second more, and a terrific crash! But in that "nick of time" he leveled off and sped away to a new world record.

The first question fired at Williams after he won the St. Louis speed race was, "How does it feel to go that fast?"

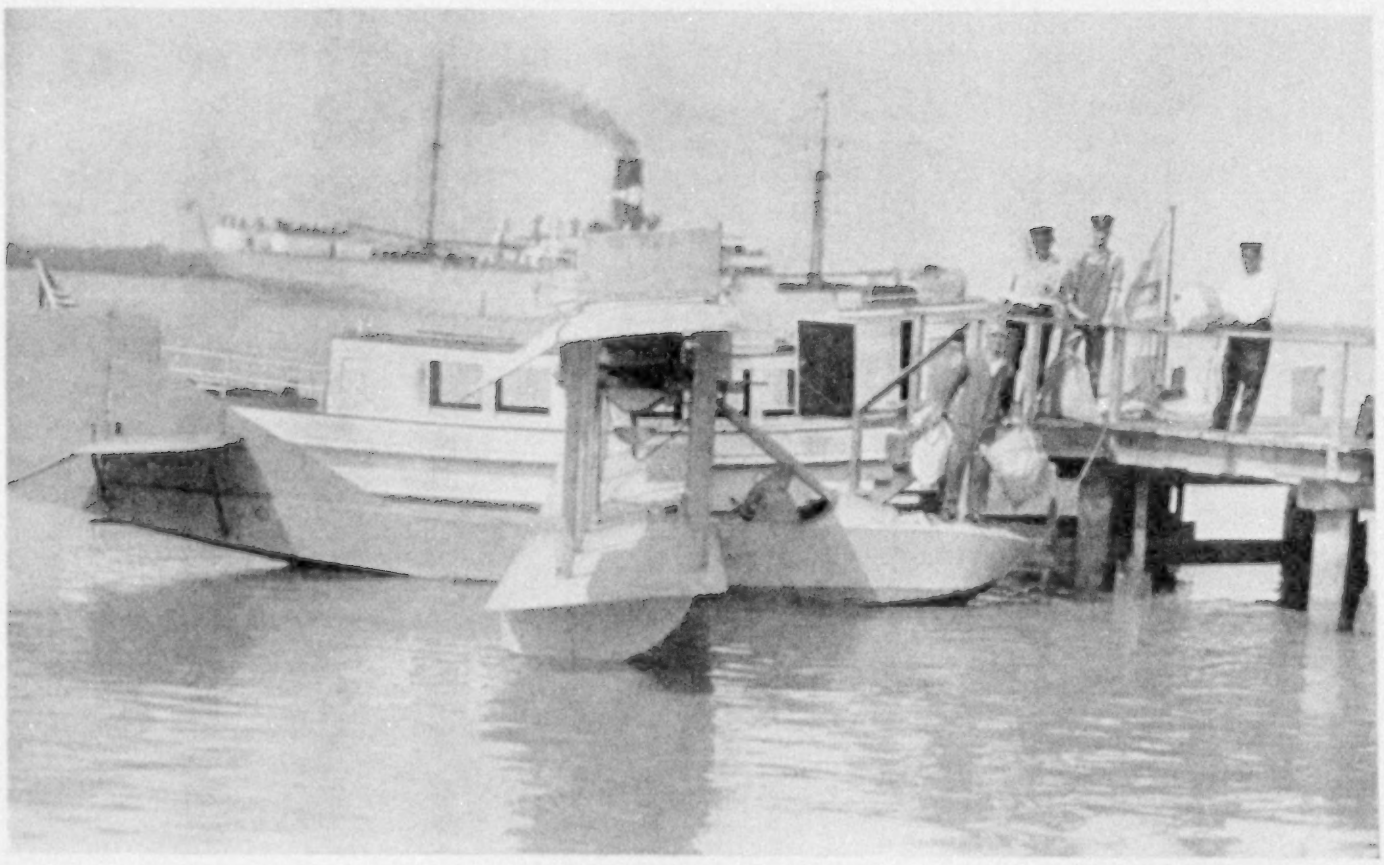
"The straightaway flying is fine, but everything went black on the turns," was his reply. Both Williams and Brow said that they seemed to lose consciousness for an instant at the sharp turns of the triangular course, where the centrifugal force jammed them down with an iron hand and apparently drained the



Official Photograph, U. S. Navy

THE SMALLEST SEAPLANE IN THE WORLD

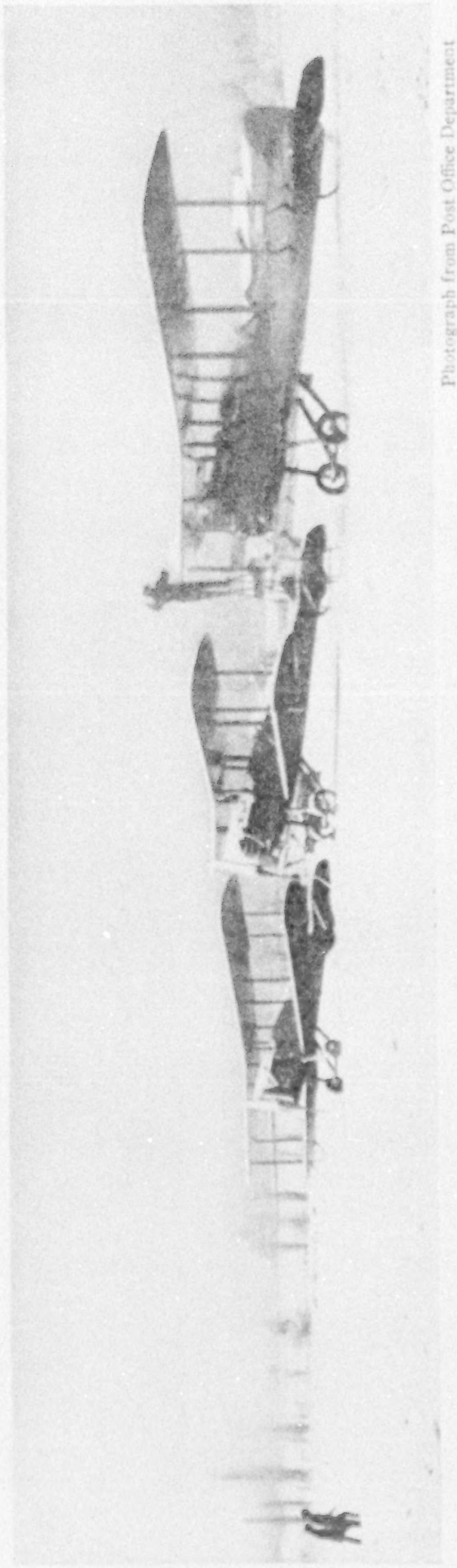
This vest-pocket craft is the U. S. Navy's last link in providing all its vessels with the aircraft which now are considered as essential to a Navy vessel's operations as its guns. The submarine airplane has all the instruments and equipment of its sister craft, yet it is only one-fortieth the size of a huge bombing plane. It is so designed that it may be shorn of its wings and stripped of its pontoons, struts and braces, and stowed in the submarine's interior.



Photograph from Post Office Department

UNLOADING THE MAIL FROM A FLYING BOAT

The planes which carry mail between New Orleans and Pilottown, Louisiana, and between Seattle and Victoria, B. C., may expedite the train-steamer transfer of mail by weeks.



Photograph from Post Office Department

CHOPPING ICE FROM THE TOPS OF AIR MAIL PLANES

A juvenile book, "The Fast Mail," probably out of print now, furnished thrills for boys of a generation that still is young. But the mail clerk's adventures are tame beside the exploits of the air postmen of to-day, sometimes tossed like whirling tops in heavy gales, often climbing two miles or more to ride the storms, and resorting to snowshoes when they are forced to land in blizzards.

blood from their heads for a few seconds.

ADMIRAL MOFFETT PREDICTS EVEN HIGHER SPEED

The question later asked of Rear Admiral Moffett, Chief of the Bureau of Aëronautics, United States Navy, was, "How fast will it be possible to go?"

"Human endurance cannot stand sharp turns at much greater speeds than those already reached," he replied. "But for straightaway flying and wide turns the limit has not been reached and is not even in sight. As for 'bumps' in the air, adequate protection can be developed for the pilot in some form of shock absorption. It will probably prove practicable to inclose him in a casing which will eliminate the air blast at 4½ miles a minute and more."

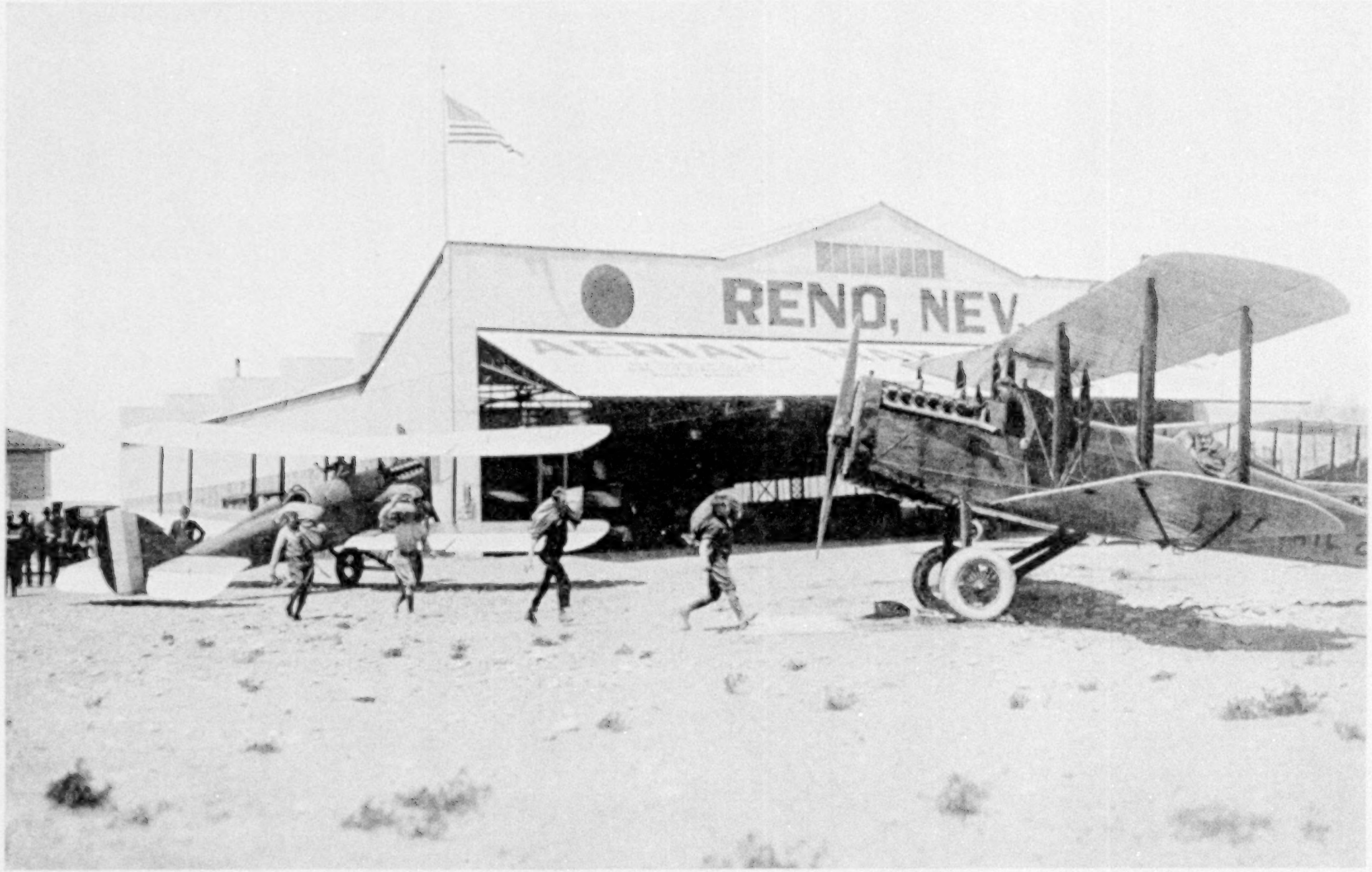
Perhaps the most heroic test of an aviator's grit and stamina is an altitude climb. The earth fades below him as he ascends to regions where no human organism has breathed before. There is no crowd to cheer, no comrade to impart morale; alone he must make the grim, grinding fight against his own failing endurance.

Artificial oxygen compensates only in part for the suffering from the difference in the pressure which he and his forbears have experienced for thousands of years. Every muscle and artery and nerve protests against the strange environment, and his vitality decreases as he goes higher and higher.

PILOT'S DASHBOARD HAS MANY DEVICES

When one boards a modern plane he is confused by the complexity of the instruments on his aërial dashboard—ten or more of them—such as the altimeter, the air-speed meter, a magnetic compass, a gyro turn indicator for use in fog or heavy rain, a tachometer to show the engine's speed, various thermometers and pressure gauges, not to mention the controls (see illustration, page 95).

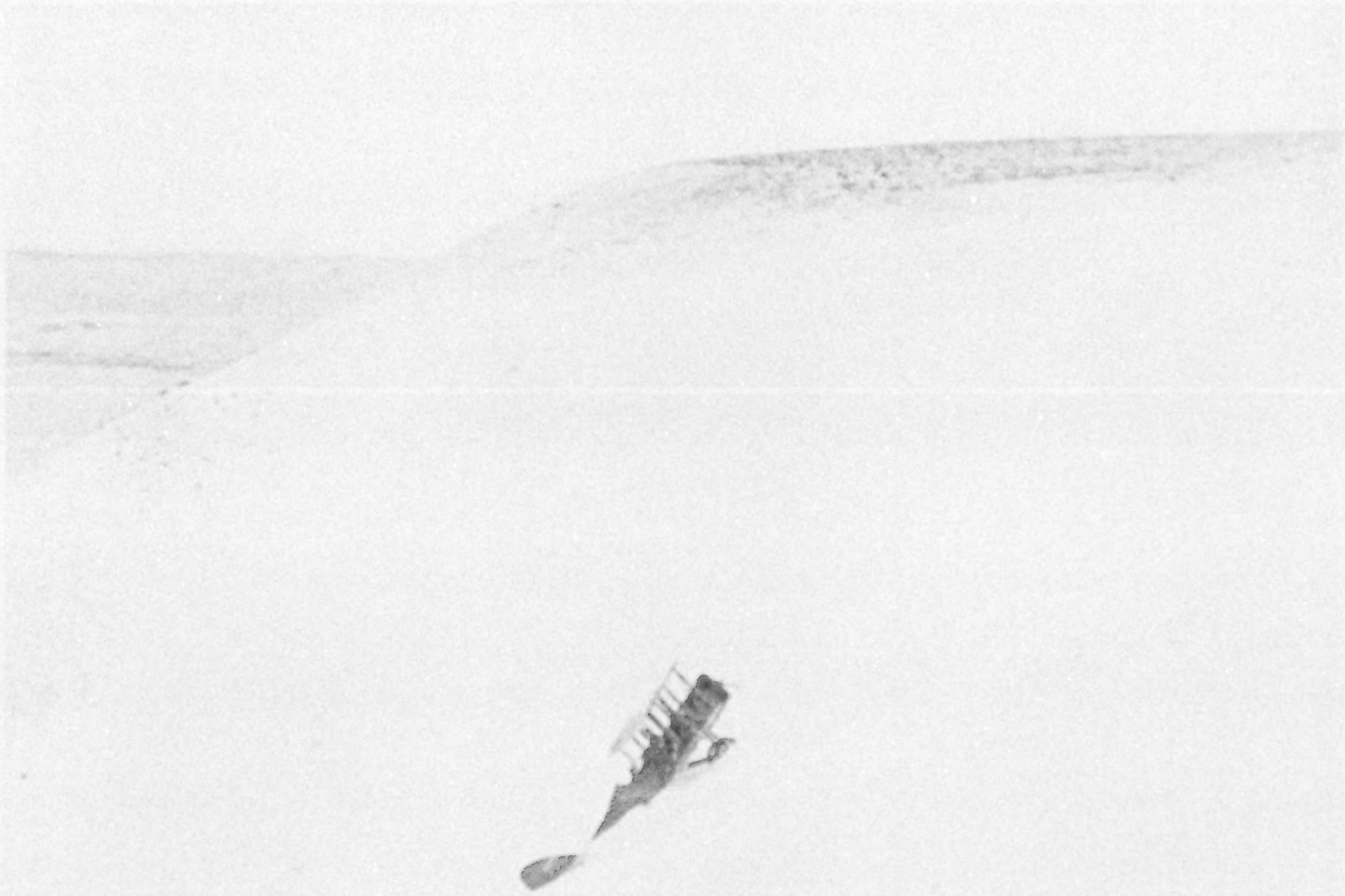
MUSEUM



Photograph from Post Office Department

TRANSFERRING AIR MAIL AT RENO, NEVADA

Relays are used to speed up the air mail service, just as frequent changes of engines are made on the fast mail trains. The doors of this hangar open in 30 seconds. The air mail fields are used by army and civilian flyers, and thus they have contributed materially to the progress of American aviation. Ask an aviator what is the greatest factor in aviation development and he probably will reply, "More flying fields."



Photographs from Post Office Department

A FORCED LANDING NEAR ROCK SPRINGS, WYOMING (SEE ALSO PAGE 26)

On the craft also probably is a radio, used in direction finding, as well as for general communication. Science continually is adding new refinements to the vehicle.

In a modern airplane, as in an automobile, the engine most decidedly is the thing. The internal combustion engine, developed by automobile manufacturers, made the airplane practicable.

The Wrights installed in their first flying machine an engine similar to the automobile engine of that day. They lightened the parts where they thought weight could be spared, and even then had an instrument which to-day would look heavy and clumsy. It generated only 12 horsepower for its 152 pounds; to-day one can lift and carry on the shoulder a 100-horsepower engine. A certain 1,000-horsepower airplane engine weighs only 1,700 pounds. A standard railroad engine, or locomotive, of 1,020 horsepower weighs 229,433 pounds.

THE NIGHTMARE OF A MOTORIST

A major problem of the airplane engine makers sounds like a motorist's nightmare—a nightmare in which the automobile driver would encounter a steep, interminable hill and drive up, up, up, and dared not pause for fear the motorcycle policeman would overtake him.

The airplane engine must keep going, without pause, at high speed, while the flyer is in the air. Overheating is one of the effects. The ingenious way this problem was attacked was by reversing the familiar operation of an automobile engine, in which the cylinders are stationary and the crankshaft revolves.

The cylinders were mounted in a star-like formation, so that they spun around

Photograph from Post Office Department

THE NEW FAST MAIL STRIKES A FOG

E. E. Mouton, air mail pilot, was forced to land on Mount Rose, Nevada. The fog was so thick that his plane was heard, but could not be seen. Rescuers reached him on snowshoes.

the crankshaft. The cylinders then cooled themselves as they revolved, and not only avoided overheating, but saved the weight of water and radiators.

In a biplane fitted with this new type of engine, Henri Farman made early airplane history at Reims, in 1909, by flying 144½ miles—a new world record for distance.

Still the demand grew for greater speed and power, until this type of engine was eliminated in certain kinds of airplanes, because the centrifugal forces were too great for the cylinder metal. The saving of fuel consequent upon the change more than compensated for the weight of water and radiator needed for cooling by the original method.

In 1924 the fierce competition of engine makers still is shaving off ounces and adding power units. The most important experiments of to-day are those directed toward the use of heavy oil fuels. Many experts agree that the next great forward step in airplane construction is the development of a motor which, like the Diesel engine, will inject fuel directly into the cylinders and fire it spontaneously. Such an engine will eliminate fire hazard and carburetor and ignition troubles, which are the weak spots of present-day motor construction.

TAKING 5,000 SNAPSHOTS A SECOND

To study this problem, a device as intricate as that used to detect air pressure on the wings has been evolved. This device is a camera which will take photographs of fuel sprays at the rate of 5,000 snapshots a second.

To realize what such photographic speed means, one may recall the day when, as a small boy, he was taken to a photographic studio and told to "hold perfectly still" for "one minute." That "minute" seemed like a lifetime; yet it was only five seconds. While he was posing for the one picture, this machine, down at the Langley Memorial Laboratory, could take 25,000 separate and distinct pictures of him!

The ignition of an ordinary safety match after striking seems spontaneous to us, but it really takes nearly a second, which is mighty slow in comparison with the 1/500th part of a second an oil jet in an oil engine requires to develop to its full size; yet during that 1/500th part of a second the new camera can take from 8 to 12 photographs of the oil spark.

Official Photograph, U. S. Army Air Service

LIEUTENANT EUGENE H. BARKSDALE LOOPING THE LOOP OVER LONG ISLAND

Next to the engine the wings (technically, the planes) are the most important elements of an airplane.

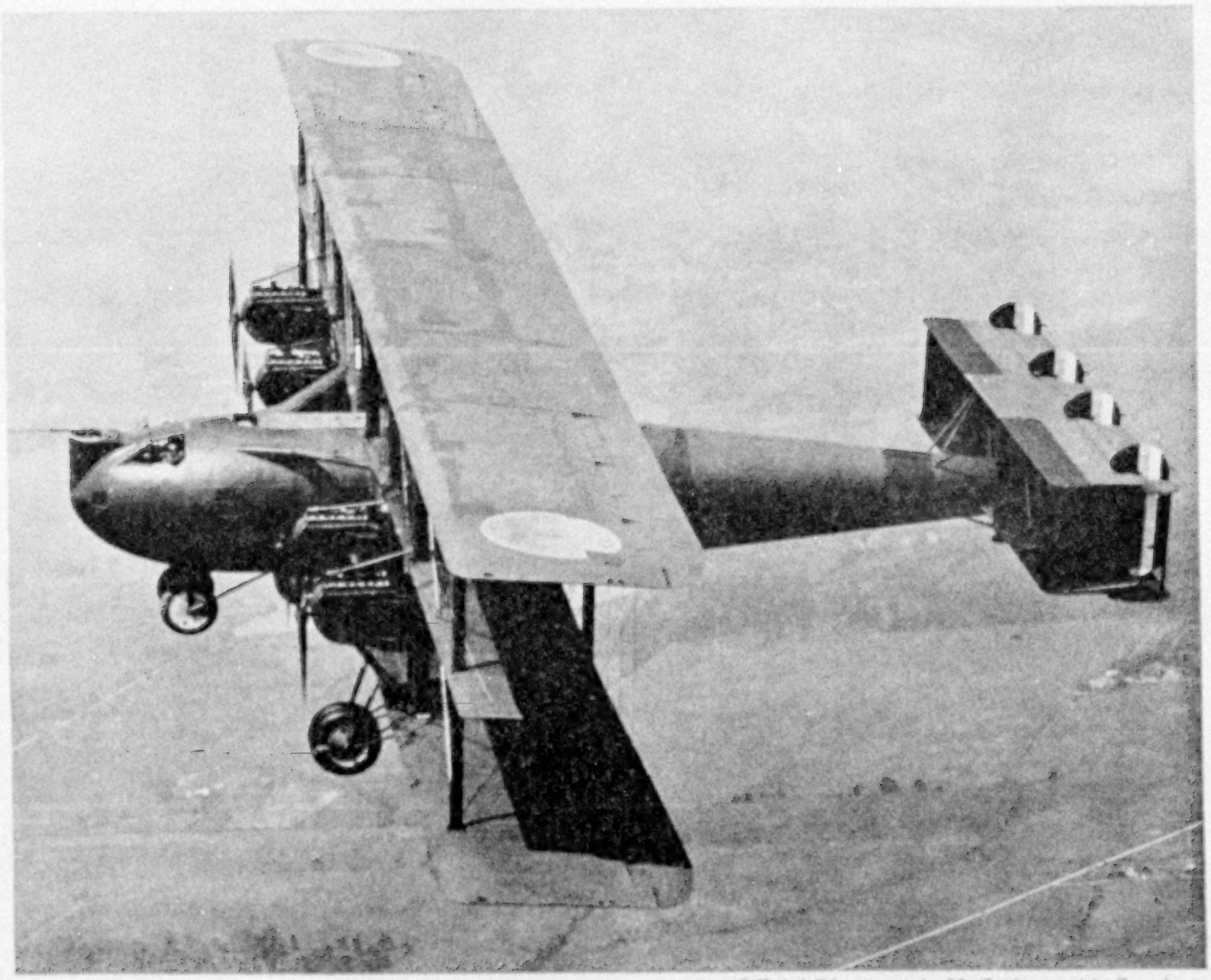
As the layman glances casually at an airplane soaring overhead, the wings seem to be the simplest part of the mechanism. Instead, they embody years of arduous, sometimes fatal, but ever fascinating, experimentation. Recent studies have upset old theories about them and have pointed the way to giving them the exceptional strength and lightness needful for the quick maneuvers and projectile speed of present-day planes.

A cross-section of an airplane wing looks like a hockey stick, with the convex side upward and the "peak" of the curve forward. One can easily see how, when the wing speeds forward, a partial vacuum is created behind the upcurved "hump." This vacuum creates a suction, and this suction, it now develops, accounts for two-thirds of the lifting power of the wing.

The air pressure on the under, concave surface, which formerly was thought to "lift" the plane, does only one-third of the work.

CATCHING AND WEIGHING THE WIND

Until very recently, it was taken for granted that pressure was distributed fairly evenly over a wing. All parts of the surface were made equally strong, and after a wing was built the method of testing it was to pile sandbags on it. Fast flying, however, and especially diving, tore off tips and upper surface covers



Official Photograph, U. S. Army Air Service

THE BARLING BOMBER, GIANT OF HEAVIER-THAN-AIR MACHINES

This airplane could pick up eight tons of coal at Scranton, Pennsylvania, and deliver it in six hours to a cellar in Chicago, if the Chicago house were on a very wide street, for the tip-to-tip measurement of the plane is 120 feet, about twice the width of the average city building lot; it is as high as a two-story house and 65 feet long.

at speeds supposed to be well within the safety factor.

Thereupon the National Advisory Committee for Aëronautics began work, at its Langley Memorial Laboratory, on an instrument which would register the pressure in thirty or forty places on the wing surface.

When this instrument was adjusted to an airplane flying at a rate supposed to engender a pressure, or "load," of 50 pounds per square foot, the telltale instrument showed that the "loads" on some wing parts registered 210 pounds per square foot, or more than 300 per cent greater than had been supposed.

This pressure-measuring instrument has a formidable name, a multiple-recording manometer; but it doesn't look complicated and would almost go into an old-fashioned "stovepipe" hat.

To employ it, a series of holes is punctured in the wing places to be tested. Each hole is connected by a rubber tube to a thin metal diaphragm. As the air pressure increases, the diaphragm bulges. To record these bulges, a small mirror is attached to reflect a beam of light on a photographic film. This mirror is adjusted so that it will revolve as the diaphragm oscillates. The photographic film traces the sensitive diaphragm movements by a zigzag line that looks like the now familiar seismograph record.

For purposes of study, the sum total of these records is modeled on a sort of contour map of the wing, the highest altitudes indicating the points of the heaviest air "loads."

This device has an unexpected application, in that results of tests made with it to measure the loads on airship surfaces

Official Photograph, U. S. Army Air Service

BRIGADIER GENERAL WILLIAM MITCHELL AND HIS SPAD AIRPLANE

To the inspiring initiative and personal achievements in the air of its Assistant Chief, the United States Army Air Service owes a large share of its remarkable accomplishments.

were applied in designing the *Shenandoah*. It is believed that the collapse of the *Roma* and the disaster of the *ZR-2* were due to lack of load information.

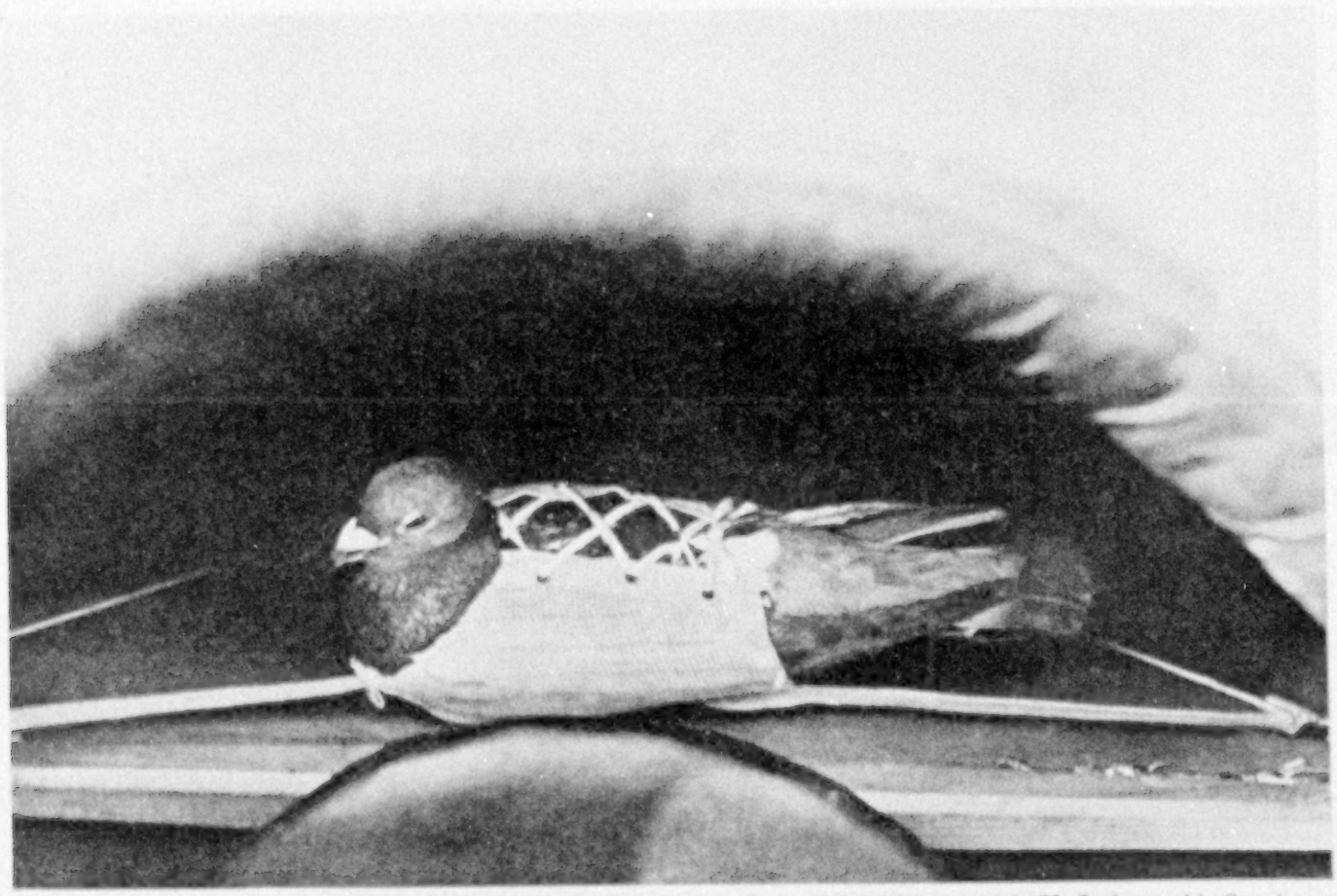
Every pilot soon will enter the air, just as the automobile driver now crosses a bridge with confidence that the carrier has been fortified to meet the stresses it will encounter.

A DIZZY PROPELLER SPEED

Conspicuous upon the Wright Brothers' first exhibition airplane were two large, ungainly propellers. To-day many airplanes have a single propeller, which attains efficiency by its strength and speed, rather than by its size. When an airplane travels 200 miles an hour, the rim of the propeller is traveling 900 feet a second. Even then the propeller is going only 2½ times faster than the plane. Naval aviation experts say that the plane propeller's efficiency is 8 per cent greater than that of the marine propeller.

Tips of the metal propellers of the Navy's new racing planes travel faster than the sound of the engine, and the centrifugal force on each blade tip is a pull of 25 tons.

In most airplanes the propeller pulls the machine. Its location in the front of



Official Photograph, U. S. Army Air Service

A PIGEON PARKS THIS GARMENT WHEN IT FLIES

When on board an airplane the homing bird is encased in a holder to keep the wings from flapping. Pigeons helped make the airplane useful for scouting purposes before the radio was perfected.

the body places it directly ahead of the pilot's seat.

When war demanded that airplanes be equipped with machine-guns, the location of the propeller in direct line of gunfire raised another pretty problem. It was solved ingeniously. A device linking the engine with the machine-gun so times the firing that the projectiles pass between the propeller blades, revolving 800 or more times a minute!

RADIO AS AN AID TO AVIATION

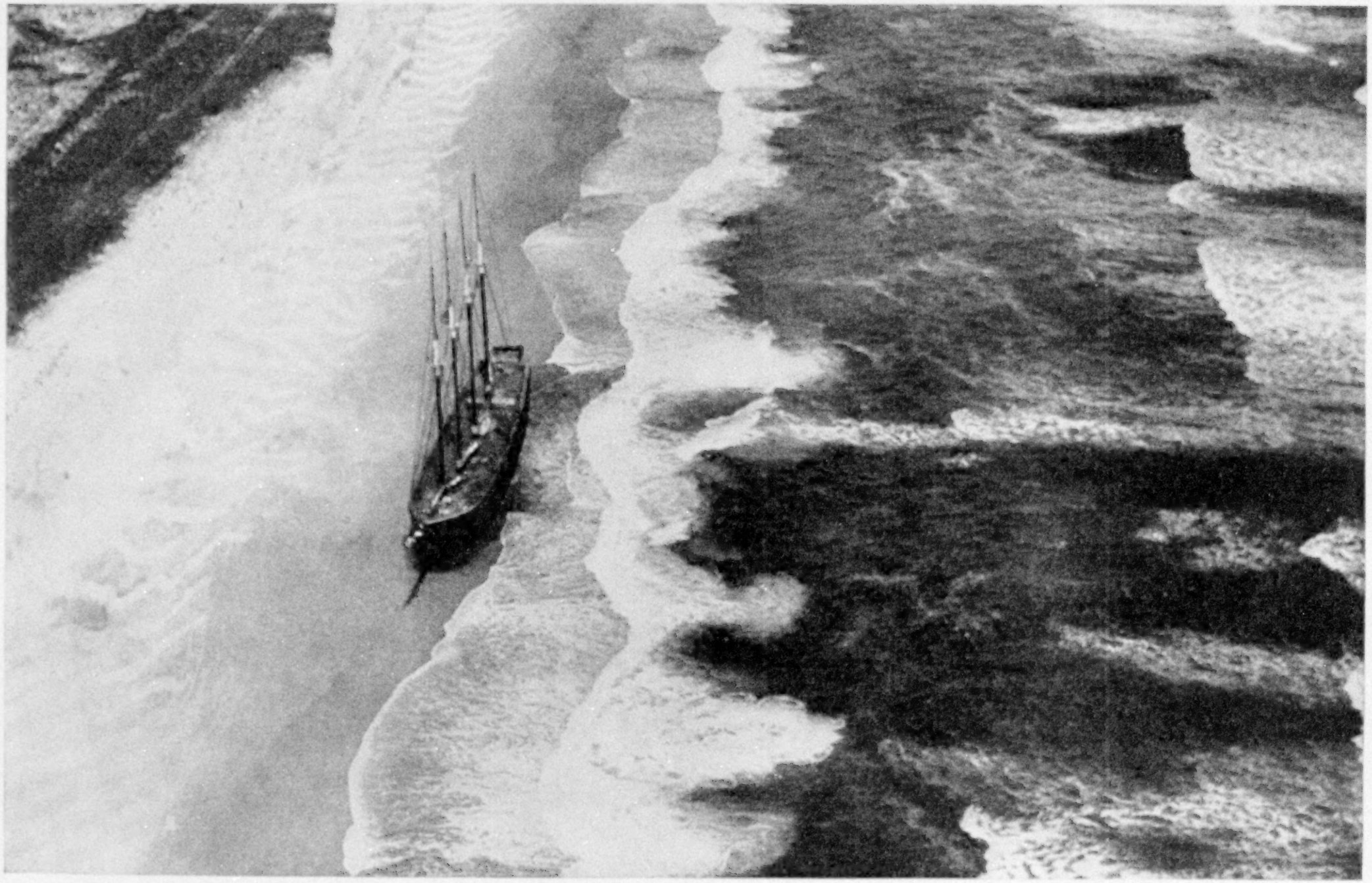
The radio is as useful in flying as the telegraph is in train dispatching. Weather forecasts are flashed to all important flying fields twice daily, and radio sets in the planes receive further advices on long flights. In England airplanes already are aiding weather predictions, daily flights being made from three fields to observe the temperature and humidity at varying altitudes. The U. S. Weather Bureau looks forward to the time when airplanes will supplant the more cumbersome balloons and kites now used for similar purposes in the United States.

The radio has another important use in aviation, that of direction finding. Especially in the Navy planes, when ground landmarks are lacking, and in land flights when these landmarks are obscured, the radio compass is utilized for aërial navigation. By using a fan-like antenna, which, revolving, registers the direction in which a signal has the highest intensity, the aviator can steer his course, even though clouds below or the darkness around him obscure ground objects.

TAKING ON FUEL IN THE AIR

A romance of flying and a romance of engineering were combined when Lieutenants Lowell H. Smith and J. P. Richter, of the Army Air Service, had breakfast in Canada, flew to Mexico in time for dinner, and had their fuel replenished three times while they were in the air.

Let your mind's eye rest on this pantomime of aërial science. The stage is more than 3,000 feet above the ground.



Pacific and Atlantic Photos

AN AIR-PICTURE RECORD OF A GROUNDED SCHOONER

An amazing variety of uses is being found for airplanes—as police patrols, for colonial administration, to exterminate mosquitos, to speed rescue parties to aid entombed miners, for honeymoon trips, and to survey inaccessible areas. This picture shows a four-masted schooner, *Ada Towers*, grounded off Patchogue, Long Island. It is low tide and the vessel is almost entirely out of water.

An airplane draws alongside another, which is flying about 100 miles an hour. One plane "tunes in" to the speed of the other and flies above it. The upper plane throws out a hose, which is caught up by one of the aviators in the plane beneath, who attaches it to his gasoline tank, and takes in 75 gallons of gasoline.

Meantime a third plane bears down upon the pair and takes motion pictures of the strange air scene.

The flyers themselves had a "bird's-eye view" of the natural grandeur of our Pacific coastal States which has been vouchsafed to only a few men.

THE FLIGHT BEGINS AT SUNRISE

Just before sunrise the airmen took off from Sumas, along the British Columbia border of Washington State, and soon passed Bellingham, with the snow-capped Mount Baker to their left. Already they could see majestic Mount Rainier in the distance. The numerous islands of Puget Sound looked like splotches from their 4,000 feet. Soon Seattle could be discerned peeking through low clouds.

Southward they flew, past Mount St. Helens, and then Mount Hood, brilliant in the morning sun, ushered them into Oregon and the rolling farmlands of the Willamette Valley.

Below Eugene they received their first "transfusion" of gas. Waving their aërial gas man goodbye, they started a gradual climb of Cascade Range, over Diamond Peak and Mount Thielsen and Crater Lake, and then entered the pass between the north end of the Trinity Mountains and the mighty Mount Shasta (see page 53).

According to Lieutenant Richter, "Only the pilots who have flown the northwest country on forest patrol can tell the thrills that chase one another up and down the old joy stick while passing over the jumbled mass of mountains, canyons, rocks, forests, bottomless pits, and turbulent rivers that extends from Mount Shasta almost to Red Bluff."

At Sacramento, with a large crowd at Mather Field to watch, the flyers took their second charge of gasoline. The sun was setting as they crossed the San Fernando Valley, and over the pass between the Sierra Madre and the Santa Monica Mountains the lights of Los Angeles greeted them.

Southeast of Los Angeles, flying 6,000 feet above San Juan Capistrano, they could still see the lights of Los Angeles, of Santa Monica, San Pedro, Long Beach, Santa Ana, Oceanside, Fall Brook, Escondido, and San Diego, and these gleaming jewels, spread at their feet like gems in a shop window, were set off by lesser light points of many other towns and villages.

Only a few minutes more and the flyers landed at Tiajuana, Mexico, after flying 1,250 miles in 12 hours and 13 minutes and performing three times a feat which, it is predicted, will make distance flying as practicable as cross-country automobile touring became when gasoline stations began to multiply.

For four years airplanes, operating under their own power, have accompanied the fleet in its winter maneuvers. This year more than 100 land planes and seaplanes returned to Hampton Roads with a total of 180,000 miles of flying to their credit.

Fleet aviation requires small combat planes, other planes for scouting, observation, and spotting gunfire, and still others for torpedo and bombing work. It can be understood, therefore, why the Navy has taken the lead in solving so many aviation problems and why naval officers say, "Our most spectacular airplane feats are maneuvers performed in the course of regular operations."

AIRPLANES PUT TO MANY USES

The practical peace-time uses of the airplane have multiplied marvelously in the last few years. A notable service the Navy performed was the mapping of the Mississippi Delta region as a preliminary to making our greatest inland waterway more navigable.

Airplanes of 1924 not only carry passengers and mail, they deliver motion-picture films and newspapers; they survey rugged coast lines and routes for new railroads; broadcast chemical dust over insect-infested crop fields; patrol forests to check fires and cruise for timber for lumber companies; write smoke screens in the sky and alight in hill-rimmed can-

XUM

Official Photograph, U. S. Navy

THE EYES OF THE FLEET

Aircraft participated with the Fleet more extensively than ever before in last winter's maneuvers which centered around the Panama Canal and Culebra Island. In addition to the squadrons which operate as separate units, some battleships are equipped with planes which are carried on board and launched from the deck by catapults. The squadrons returned to their home port at Hampton Roads headed by the *PN-7*, flag plane of the Scouting Fleet Squadrons.

yons; locate schools of fish and take sight-seers over the Alps.

The British Government has turned over its administration of central Iraq (Mesopotamia) to the Royal Air Force, while French officials make colonial inspection trips in airplanes, and our own Marine Corps uses airplanes for police work and garrison duty in Haiti.

Recently, in our own country, the first aërial stowaway was arrested, a machinist attracted passing attention by using a plane for his honeymoon, and commercial concerns offered their aircraft to the Post Office Department as "strike-breakers" in the face of a threatened railroad strike.

National Geographic Society members have a special interest in aviation. Indeed, the long-time members of The Society, as they look back through their files at the early attention paid to aëronautics and the important findings first published in their Magazine, justifiably feel themselves sustaining pioneers of aviation.

Their GEOGRAPHIC MAGAZINE has been enriched by remarkable examples of aërial photography, and they have enjoyed aviators' contributions to the literature of travel, such as Sir Ross Smith's memorable narrative of his London-to-Australia voyage,* and Captain St. Clair Streett's account of the United States Army's Air Squadron flight from New York to Nome, Alaska, previously mentioned.

* See "From London to Australia by Aëroplane," by Sir Ross Smith, K. B. E., in THE GEOGRAPHIC for March, 1921.

FIFTEEN VEGETABLES IN ONE SOUP!

Vegetables of such extraordinary quality that no home could hope to obtain them for its regular supply!

This is one reason so many people say Campbell's Vegetable Soup is the best they ever tasted.

It takes a large number of ingredients and just the right kind of ingredients to make such exceptionally good vegetable soup.

Campbell's Vegetable Soup has thirty-two different ingredients. And they are the best that money can buy.

So hearty that it is eaten frequently as a meal.

So delicious that it's famous!

21 kinds **12 cents a can**

Luncheon
Dinner ~ Supper

Our colors are Red-and-White,
Let's cheer them each noon and night,
For they're on the Label
That brings to our table
The Campbell's we eat with delight!

The Switchboard Comes to Life

Zero hour approaches. Wire chief and assistants are set for the "cut-over" that will bring a new central office into being.

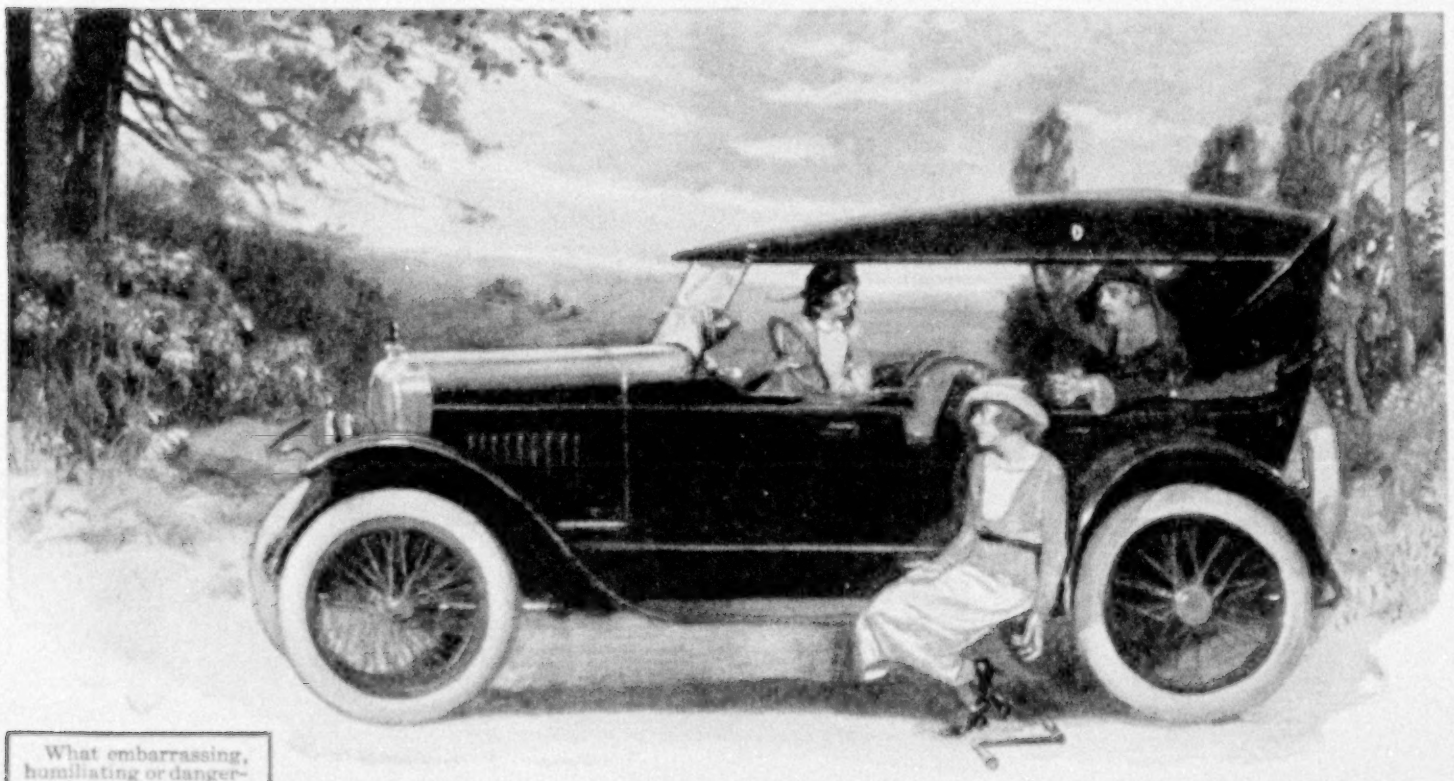
In the room above operators sit at the new switchboard. Two years this equipment has been building. It embodies the developments of hundreds of engineers and incorporates the scientific research of several decades. Now it is ready, tested in its parts but unused as an implement of service.

In the terminal room men stand in line before frames of myriad wires, the connections broken by tiny insulators. Midnight comes. A handkerchief is waved. The insulators are ripped from the frames. In a second the new switchboard becomes a thing alive. Without their knowledge thousands of subscribers are transferred from the old switchboard to the new. Even a chance conversation begun through the old board is continued without interruption through the new. The new exchange provides for further growth.

This cut-over of a switchboard is but one example, one of many engineering achievements that have made possible a wider and prompter use of the telephone.

To-day, in maintaining a national telephone service, the American Telephone and Telegraph Company, through its engineering and research departments, continuously makes available for its Associated Companies improvements in apparatus and in methods of operation.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES
BELL SYSTEM
One Policy, One System, Universal Service



What embarrassing, humiliating or dangerous experiences have you had with ordinary batteries? Write us.

—and then she got her Philco!

Cranking a car is "no business for a lady"—or a man, either. In the emergencies—on lonely roads, railroad crossings or traffic-jammed streets—*safety* itself *demands* Philco power and Philco dependability.

That's why veteran car owners insist on Philco Batteries. They know that with a touch of the starter—a mighty surge of Philco's motor-whirling power—they're off! No hang-ups in traffic. No hand-cranking. No bitter experiences.

Why take chances on just an ordinary battery—especially when you can get a full-size, full-powered, dependable battery made by Philco for $15.95 up?—depending on type and geographical location.

For maximum protection against battery failure—for quickest starts, brightest lights and sure-fire ignition—get a famous over-size two-year-guaranteed Philco Diamond-Grid Battery with Philco Retainers. This is also the lowest-cost-per-month-of-service battery ever built. Get your Philco now.

Philadelphia Storage Battery Company
Philadelphia

PHILCO Farm Lighting · Radio · Electric Truck · Industrial Tractors · Passenger Cars · Mine Locomotives · Auxiliary Power · Marine · Isolated Plant *BATTERIES*

RADIO

Philco Rechargeable Glass Case Batteries contain the exclusive Philco built-in Charge Indicator, which tells at a glance WITHOUT the use of a hydrometer how far a battery is charged or discharged. They are absolutely acid-tight and may be used inside the finest cabinets.

Recharging with the safe, low-current Philco Charger and a throw-over switch is easy, simple and NOISELESS. Insure Distance, Volume and Clearness of reception by having your set "Philco Equipped."

You can get Philco Batteries from your nearest Philco Service Station, Radio or Music Dealer.

PHILCO DIAMOND GRID **BATTERIES**

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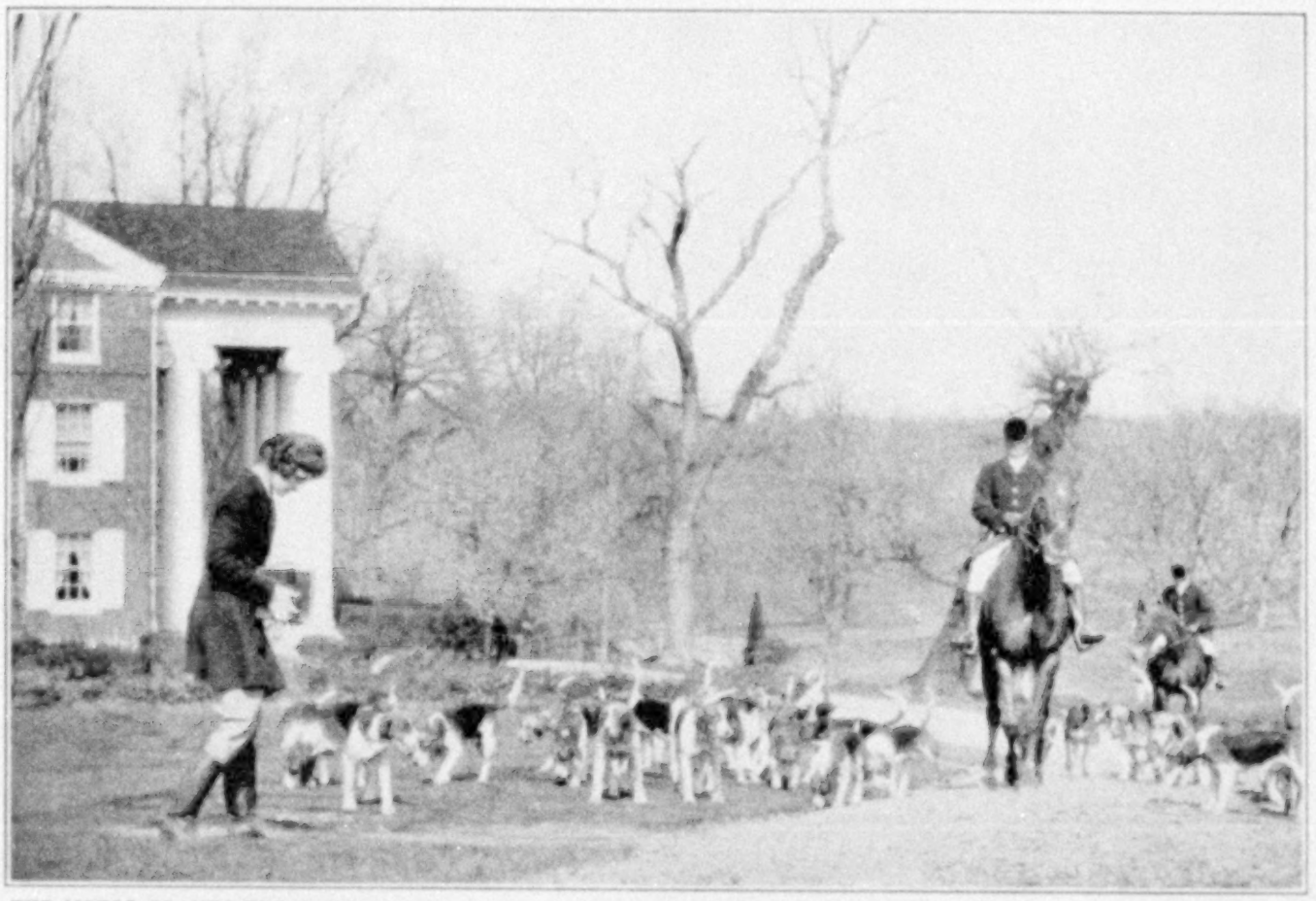


THE MOTOR CRANKS THE CAMERA

The Ciné-Kodak makes *motion* pictures

Take a Ciné-Kodak along on your trip. Whether the scene is as unusual as a fox hunt or as plain "ornery" as a mule on a rough trail you will have exceptional opportunity for pictures. And think of the delight of having these precious travel scenes in *motion*.

Home again you can show, on your own screen, your trip through the Yellowstone or your journey abroad, in pictures that *live*.

It's all easy—emphatically so. Press the button, the motor cranks the camera and "we do the rest."

This Eastman invention has reduced the operating expense 80 per cent as compared with outfits using standard width film. Price complete, $335 including Ciné-Kodak, with either tripod and crank or motor drive, Screen and Kodascope to project not only your pictures but professional travel pictures, comedies, dramas, which may be rented from Kodascope Libraries, Inc.

Ask your dealer for booklet "Motion Pictures the Kodak Way" or write us

Eastman Kodak Company, Rochester, N.Y., *The Kodak City*

STARTED IN 1842

Whitman's Sampler

CONTAINING

"Fussy" Chocolates
Honey White Nougat
Chocolate Covered Mint Marshmallows
Chocolate Covered Caramels
Chocolate Covered Liquid Cherries
Chocolate Covered Brazil Nuts
"1842" Bitter Sweets
Jordan Almonds
Chocolate Cream Mints
Chocolate Covered Almonds

U.S. Royal Cords

IT wasn't so long ago that most men made quite a ceremony of buying a tire—and even then paid out their money with some doubts.

Today when a Royal Cord user wants a new tire, he buys another Royal because there is no other reasonable thing to do.

You don't find the Royal Cord user at all ready to carry on mileage experiments — at his own expense.

Each Royal Cord he buys does more than he would have asked of it.

Trade Mark

United States Rubber Company

U. S. Tires are the only tires in the world made of cords solutioned in raw rubber latex

UNITED STATES TIRES ARE GOOD TIRES

Economical, Care-Free Service Far Above Its Price-Class

It is not too much to say that the good Maxwell is one of the most skillfully engineered cars in America.

It is likewise true that in many processes of its production important economies, with better and finer results, have been achieved.

Translated into concrete terms, this means a car selling for considerably less than $1,000, that accelerates from 5 to 25 miles an hour in eight seconds;

That rides with the ease and buoyancy heretofore expected and encountered only in cars of higher price;

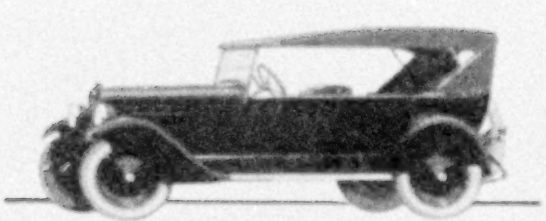
That delivers its reliable mileage at maintenance and operating costs so low as literally to amaze.

How good Maxwell engineering saves the owner money is illustrated by a score or more of structural details

Take, for instance, the piston wrist pin. Grinding out a slot for the connecting rod bolt is accepted practice

But this practice weakens the wrist pin at the point of greatest stress. Maxwell engineers create the bolt-slot by depressing the pin, leaving the pin the same thickness all the way through, and taking away none of its strength.

Result: Maxwell has never had one complaint regarding a broken wrist pin—which means that good Maxwell owners are relieved of a very expensive repair.



The Good Maxwell Touring Car

In ordinary construction, the power impulses, however smooth the motor may be, are transmitted to the chassis, while shock and vibration due to road roughness are likewise transmitted to the motor.

The front end of the good Maxwell motor is mounted upon a floating platform spring, which actually increases motor smoothness and protects the motor from road shock.

The same farsighted engineering has devised automatic and positive lubrication for the clutch release bearing, thus eliminating what is a source of trouble and expense in many cars.

So throughout the entire car—at every turn, advanced engineering and precision manufacturing save for the owner.

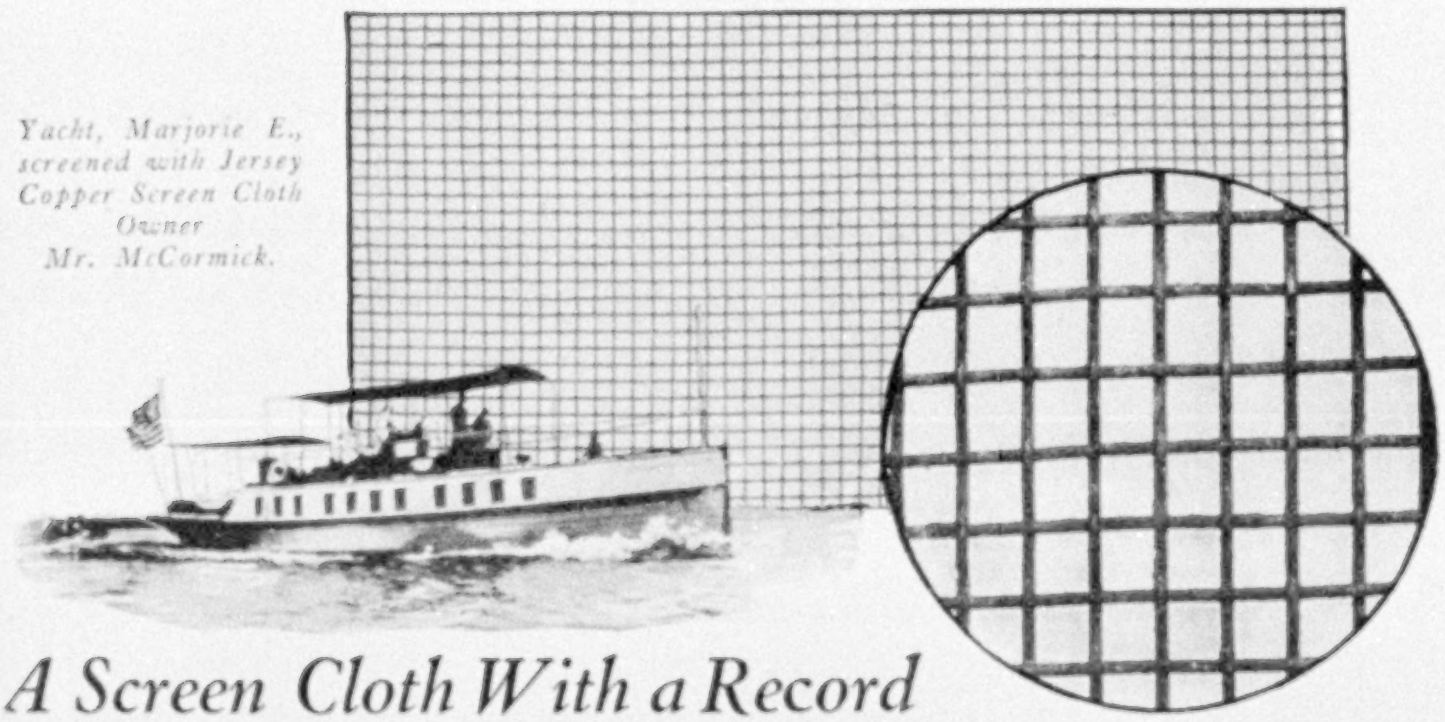
If there is any secret about good Maxwell durability, reliability, and satisfaction, it is told by Maxwell knowledge of where to save, and where to spend without limit.

So, in the good Maxwell, the buyer gets a car that provides economy in the price, and even more important economy in the low cost for which it returns its reliable, care-free service.

All Maxwell dealers are in position to extend the convenience of time-payments. Ask about Maxwell's attractive plan.

MAXWELL MOTOR SALES CORPORATION, DETROIT, MICHIGAN
Walter P. Chrysler, President and Chairman of the Board
MAXWELL-CHRYSLER MOTOR COMPANY OF CANADA, LIMITED, WINDSOR, ONTARIO

The Good MAXWELL



Yacht, Marjorie E., screened with Jersey Copper Screen Cloth Owner Mr. McCormick.

A Screen Cloth With a Record of More Than 12 Years' Service

Metal screen cloth can be subjected to no more severe test than that imposed by the damp, salt-laden air of the seacoast.

Here, then, is a record worthy of your attention.

The piece of screen cloth pictured above was taken from the yacht of Mr. McCormick (of McCormick and French, Architects, Wilkes Barre, Pa.) after it had seen nearly 13 years of active service.

Mr. McCormick says:

> *"There are eleven (11) windows on each side, ALL of which were covered on the outside with your Copper Insect Screen Cloth when the boat was built, in 1910. They have never been renewed and are all in perfect condition, and to all appearances will last another thirteen (13) years."*

Jersey Copper Insect Screen Cloth is enthusiastically endorsed by Home Owners, Architects and Builders, who use it—both on account of the great durability and its *unusual stiffness and strength*. Unlike ordinary copper screen cloth it will *not* stretch or bulge, owing to a special Roebling process which gives the wires stiffness and strength comparable to that of steel.

If you cannot readily obtain Jersey Copper Screen Cloth in your locality, write us and we will tell you how to get it, also send you an interesting booklet, "A Matter of Health and Comfort," which you will find well worth reading.

THE NEW JERSEY WIRE CLOTH COMPANY
632 South Broad Street
Trenton New Jersey

In the oblong panel

is shown an unretouched photograph, actual size, of the copper screen cloth, heavy grade, taken from Mr. McCormick's yacht after nearly 13 years' service along the Atlantic Seacoast. Its general condition speaks for itself.

In the circle

is an enlarged view (magnified 4 diameters) of a part of the same cloth. It is interesting to note that though the metal has corroded (for *all* metals commonly used by man *will* corrode) even after 12 years this corrosion is not sufficient to weaken the metal materially. Note, also, that the surface of the metal has been affected *evenly*. This is because the cloth is made of wire which is absolutely uniform in composition—*99.8% pure copper*.

TRADE JERSEY MARK
COPPER
Screen Cloth
Made of Copper 99.8% Pure

Take a Kodak with you

Autographic Kodaks *$6.50 up*

Eastman Kodak Company, Rochester, N.Y., *The Kodak City*

Few people could resist this bargain in note paper

NOW you can purchase almost a year's supply of charming "personal" stationery for a dollar.

Everybody sees the practical need of it; our customers include some of the wealthiest men and women in the country; they re-order again and again.

The paper is the kind to be proud of—clear, smooth, fine quality National Bank Bond—a Butler paper. You know what that means—an exceptional value.

Your name appears in trim blue Gothic letters—ever a tasteful mark of identification.

Stationery like this may be used with perfect propriety for most all occasions.

For such matters as a note to tradespeople, the doctor, the dentist, club members, a chatty line to a friend or the youngsters away on vacation, it is pretty nearly ideal.

200
note sheets
100
envelopes
printed with your name and address
for $1.00

Let us send you a box today. Merely write—better still, print your name on a slip of paper, enclose $1 and mail and we'll ship immediately, prepaid. Or if inconvenient, we will ship C. O. D.

Outside U. S. A. and West of Denver add 10% to remittance.

AMERICAN STATIONERY COMPANY
503 Park Avenue, Peru, Indiana

Men Who Care

For whiter teeth are now fighting film

Wherever you go among careful people you see teeth that glisten now. Millions of people every day combat the dingy film.

This test will show you how. The results will amaze and delight you. Make it, for your own sake, now.

Those dingy coats

Film is that viscous coat you feel. Much of it resists the toothbrush, clings and stays. Soon the film discolors, then it forms dingy coats which hide the luster of the teeth.

Film also causes most tooth troubles. It holds food substance which ferments and forms acid. It holds the acid in contact with the teeth to cause decay.

Germs breed by millions in film. They, with tartar, are the chief cause of pyorrhea.

Few people escaped these troubles. So dental science has found two ways to daily fight that film. One acts to disintegrate the film, the other to remove it without harmful scouring.

After many careful tests these methods were adopted. A new-type tooth paste was created to apply them daily. The name is Pepsodent. Now leading dentists the world over are urging its adoption.

Watch its effects

Pepsodent also multiplies the alkalinity of the saliva as well as the starch digestant in saliva. Those agents are there to constantly fight acids and digest starch deposits on teeth. Every use of Pepsodent gives them manifold effect.

Thus Pepsodent does essential things which old ways cannot do. The results are quickly seen and felt. No one can doubt the benefits they bring.

Send the coupon for a 10-Day Tube. Note how clean the teeth feel after using. Mark the absence of the viscous film. See how teeth become whiter as the cloudy coats disappear.

Once learn this way to whiter, cleaner, safer teeth and you will always want them. Cut out coupon now.

Protect the Enamel

Pepsodent disintegrates the film, then removes it with an agent far softer than enamel. Never use a film combatant which contains harsh grit.

Pepsodent
REG. U.S. PAT. OFF.

The New-Day Dentifrice

Now advised by leading dentists the world over

CUT OUT THE COUPON NOW

10-DAY TUBE FREE 1609

THE PEPSODENT COMPANY
Dept. 38, 1104 S. Wabash Ave., Chicago, Ill.
Mail 10-Day Tube of Pepsodent to

Only one tube to a family.

Moderately Priced PERGOLAS

Your garden's beauty, the entire effect of your grounds, will be improved by an artistically designed and correctly placed pergola, shelter house, or rose arbor.

Because we specialize in such work, we are able to offer you pergolas, and garden equipment of all kinds, at a very moderate cost—less than such work costs when done unskillfully by local carpenters.

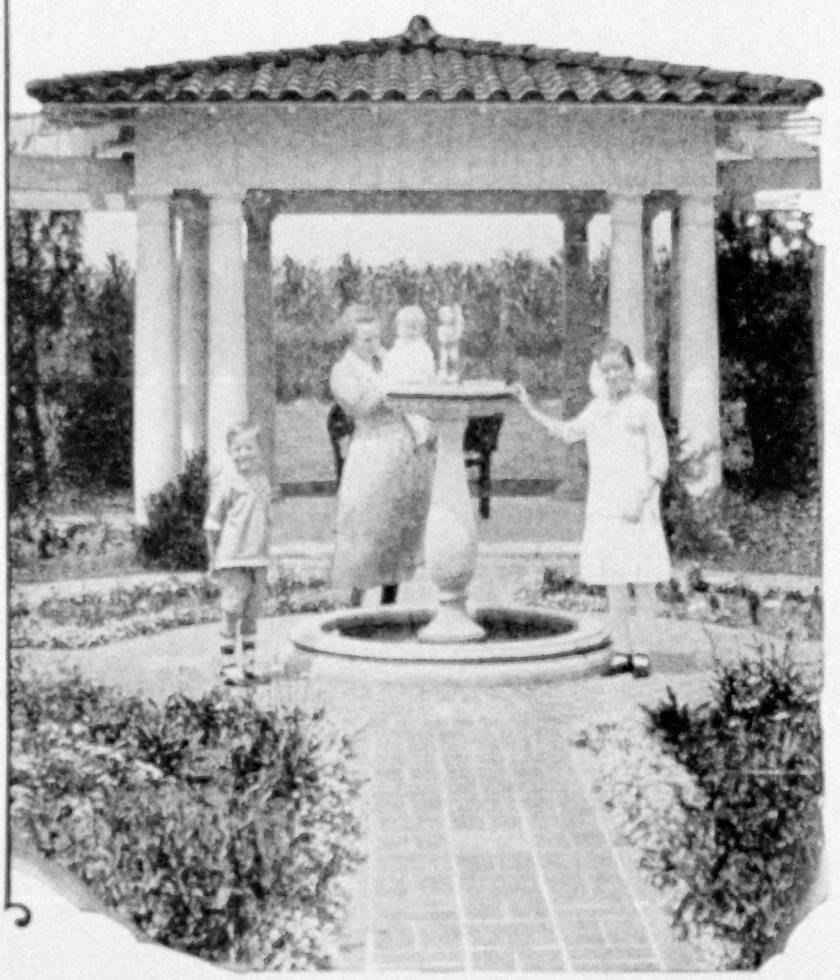
From us you get materials that are chosen for the purpose, put together by experts. All columns used are Koll Lock-Joint Columns—they will not, *cannot*, come apart.

Send 30c for Garden Equipment Catalog N-34, showing pergolas, garden houses, lattice fences, trellises, rose arbors, sundials, fountains, bird-baths, gazing globes, lawn umbrellas, and garden and beach furniture.

Hartmann-Sanders Company,
2187 Elston Avenue, Chicago
Showrooms: 6 East 39th St., New York City

HARTMANN-SANDERS
Koll Lock-Joint Columns—Pergolas—Rose Arbors
Garden Furniture and Accessories

KOLL LOCK-JOINT COLUMN
THEY CANNOT COME APART



BRAND'S
GOLD MEDAL PEONIES

AT the 1923 National Show of the American Peony Society, in competition with growers from Massachusetts to North Dakota, the Brand Peony Farms was awarded the three highest prizes.

(1) Gold Medal on finest collection, 100 varieties.

(2) Gold Medal on magnificent new white seedling peony—Mrs. A. M. Brand.

(3) Silver Medal on wonderful new pink seedling peony—Myrtle Gentry.

Competent judges declared the Brand Peony Farms exhibit to be the "greatest display" of new peonies ever shown.

You will want to plant roots from this prize-winning stock—let our Peony Manual guide you. It is a book giving the history of the peony, varieties, culture, etc. Free to those purchasing roots; otherwise 35c.

THE BRAND PEONY FARMS
Box 25, Faribault, Minn.

RECORDED FOR ALL TIME

Let us assist you in deciding upon the memorial best suited to your specific purpose.

Booklet "C" sent upon request

HARRISON GRANITE COMPANY, Inc.
200 Fifth Avenue *Established 1845* New York, N. Y.
Offices: Detroit Chicago Pittsburgh Minneapolis
Works: Barre, Vermont

BIASCOPE $5
Pocket Binocular

For short trips or long tours in every outdoor activity the efficient Biascope means added pleasure.

$5 and $7 at dealers. By mail add $.25
Money-back guarantee. Circulars free.

Wollensak Optical Company
Rochester, N. Y.

COLGATE'S

Shaving Stick

"HANDY GRIP" AND REFILL

For Comfort, Convenience and Economy

When we say to you that the Shaving Stick has important advantages over shaving preparations in any other form, we can do so without bias, for we manufacture shaving sticks, powder and cream.

In its attractive nickel box, our "Handy Grip" Shaving Stick is most convenient for traveling. It will not crush when packed, and it makes a wonderful lather for *easy* shaving.

It is not uncommon for a Colgate Shaving Stick to last more than a year in daily use.

The famous "Handy Grip", with a trial-size shaving stick in nickel box, sent for 10c. When the trial stick is gone, buy Colgate "Refills" for the price of the soap alone, 25c.

COLGATE & CO. Dept. 66, 199 Fulton St. NEW YORK

Via Honolulu to the FAR EAST

A MAGIC world of tinkling bells, bright blossoms, strange customs—yet a world in which the American traveler finds every convenience and comfort to which he is accustomed.

One of five great sister ships sails every two weeks over the Sunshine Belt from San Francisco to Honolulu. After a day's stopover at Honolulu with its famed hospitality, flowers, dances and beaches—on to Yokohama, Kobe, Shanghai, Hong Kong and Manila.

The ships and next sailings are:

Pres. Wilson	July 22	Sept. 30
Pres. Lincoln	Aug. 5	Oct. 14
Pres. Cleveland	Aug. 19	Oct. 28
Pres. Pierce	Sept. 2	Nov. 11
Pres. Taft	Sept. 16	Nov. 25

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Please send me the booklets giving travel facts about the Orient and the Pacific Mail S. S. Co.

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2000 Miles of Alpine Canada
and Sheltered Scenic Seas

Sheltered Scenic Seas of the North Pacific Coast

HERE are three incomparable, "Canadian National" vacation tours you can make at one time, or separately, at moderate expense:—

1. *Visit Jasper National Park,* the largest in America, stopping at Jasper Park Lodge ($6 up American plan). Accomodations for 350 guests in an Alpine wonderland of 4,400 square miles of scenic glories in the Canadian Rockies.

2. *CrossAmerica* the Canadian National way—a tour beyond imagination—including Jasper National Park, Mt. Robson, giant glaciers, tremendous gorges and tumbling rivers.

3. *Take the Triangle Tour* of British Columbia starting at Jasper National Park, through the highest Canadian Rockies to Prince Rupert; then 550 miles by steamer through "America's Norway" to Vancouver; back to Jasper by rail through glorious mountains—1200 miles of painted, snow-crowned mountains, rushing rivers and green forests.

Ask for tourist fares, stopover privileges and illustrated booklets.

Offices in the United States

Boston—333 Washington St.
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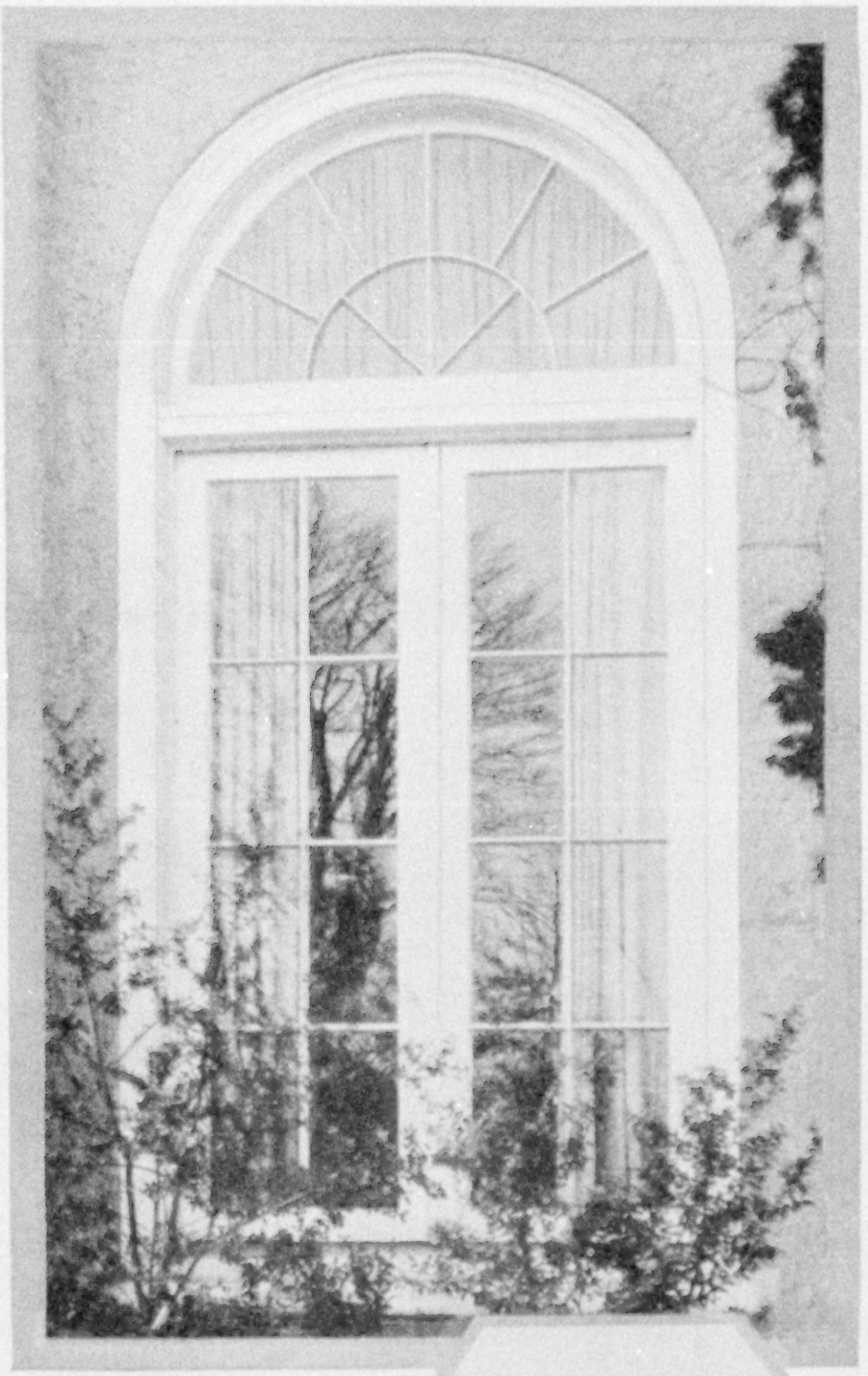
Chicago—108 West Adams St.
Cincinnati—406 Traction Bldg.
Cleveland—948 Union Trust Building
Detroit—1259 Griswold St.
Duluth—430 West Superior St.
Kansas City—334-335 Railway Exchange Bldg.
Los Angeles—503 So. Spring St.
Minneapolis—518 2nd Ave. South
New York—1270 B'way, Cor. 33d St.
Philadelphia—401 Franklin Trust Building
Pittsburgh—505 Park Bldg.
Portland, Me.—Grand Trunk Ry. Sta.
Portland, Ore.—120½ Third St.
St. Louis—305 Merchants Laclede Bldg.
St. Paul—Cor. 4th and Jackson Sts.
San Francisco—689 Market St.
Seattle—902 Second Ave.

No Passports Required

CANADIAN NATIONAL RAILWAYS

The Largest Railway System in the World

Like the unrippled surface of a woodland pool, Plate Glass faithfully reflects lights and shadows. Its beautifully polished surfaces catch the highlights and shadows of nature's pictures and reflect them with a fidelity and brilliance impossible to any other glass. The architectural value of this characteristic of Plate Glass is apparent in any residence.



REFLECTED BEAUTY

WINDOWS, like other architectural features, are essential elements of a building's character. Plate Glass in the windows makes an amazing difference. It transforms the appearance of the entire house.

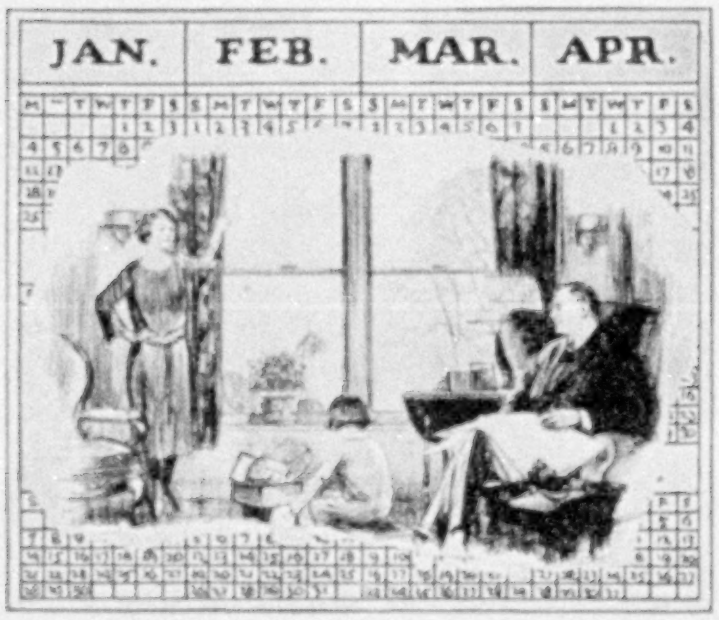
Yet Plate Glass is not an expensive item in any house. Its cost is not more than 1 per cent of the total cost of the house, and is many times repaid in increased rentability and salability. Your architect will gladly furnish you comparative figures.

PLATE GLASS MANUFACTURERS *of* AMERICA

Use PLATE Glass ©

Nothing Else is Like it ©

PROTECTION
That Pays All Year Round



Keeps out dust, dirt, soot, and smoke—saves household labor—keeps wall paper and decorations fresh and clean—saves 25% to 40% on fuel.

These comforts are saving and paying for themselves every day in the year. They are a necessity of good household economy.

It will pay you to investigate the cost of installing Chamberlin Metal Weather Strips in your home. They are not expensive. The experience of thousands shows that their cost is more than saved on fuel alone.

And think of the comfort they give—the protection against dust, dirt, and soot constantly sifting in. They end this fight against needless dirt—a tedious labor removed from daily tasks.

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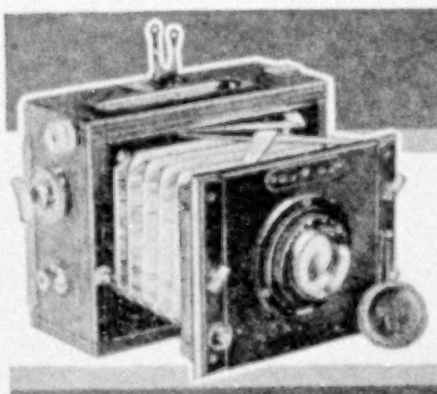
Eng. Dept., A-12



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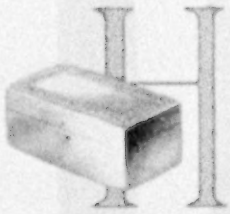

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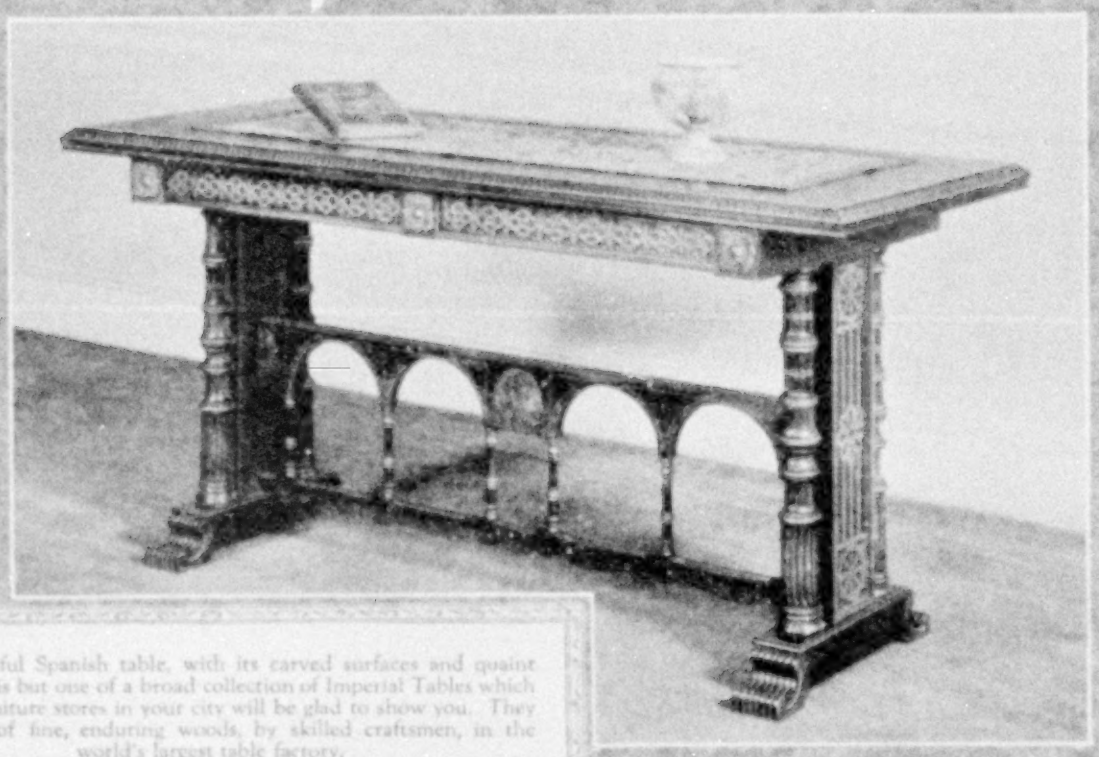

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7-24

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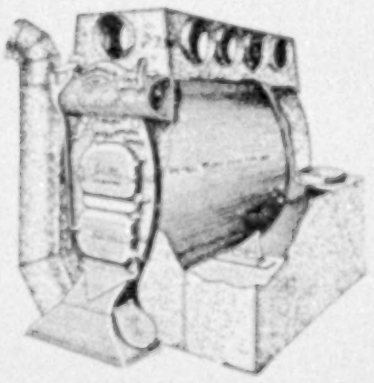

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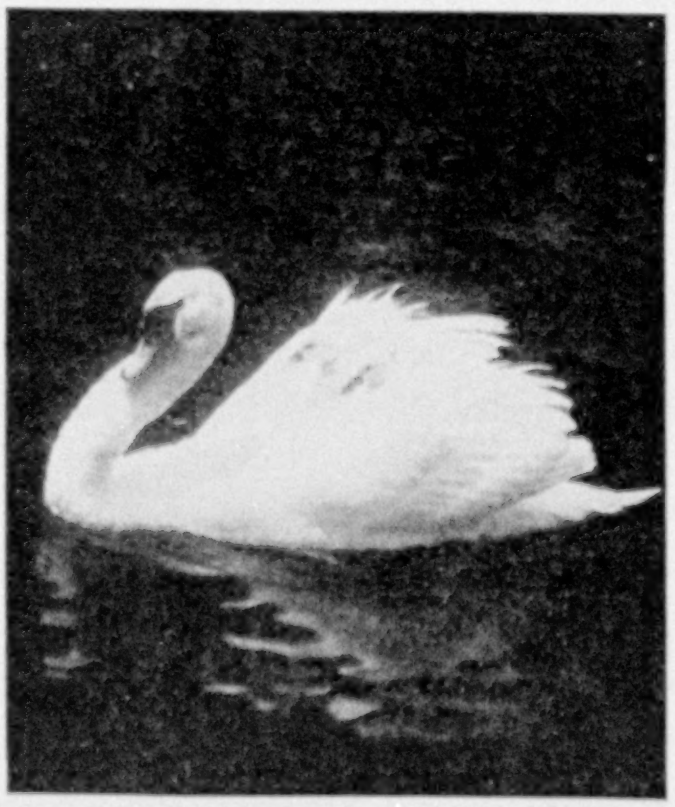

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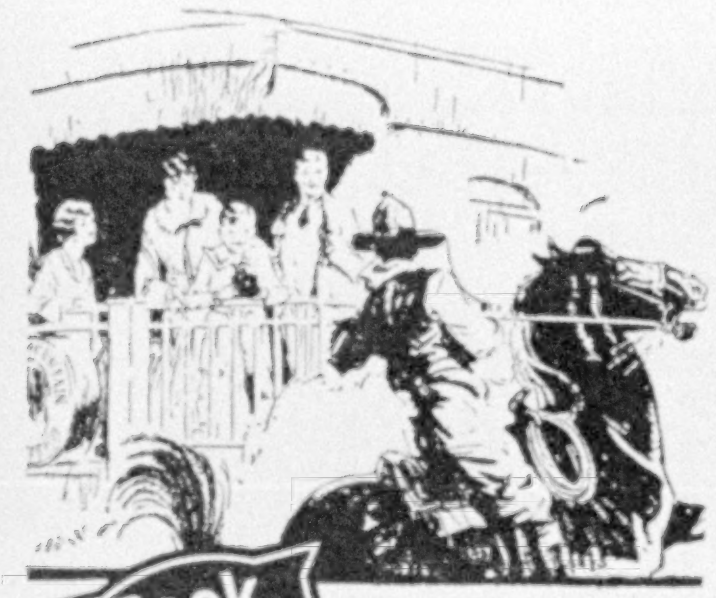

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Cleans Closet Bowls Without Scouring

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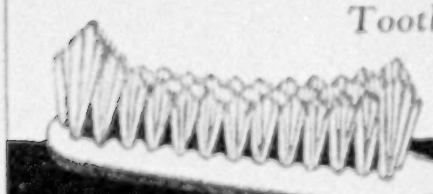

Toothless means youthless—Save your teeth by fighting tartar with frequent brushing, the Pro-phy-lac-tic way.

Pro-phy-lac-tic.

This X-Ray shows tooth-socket destruction by pyorrhea.

White teeth—

but what would the X-Ray show?

BEAUTIFUL, white teeth, free from decay, are not safe unless the gums are healthy. If pyorrhea attacks your gums, an X-Ray would reveal how quickly the infection spreads to the root sockets which hold the teeth in place. If pyorrhea is not checked, your teeth fall out—or must be pulled—because their support is gone.

Tender, bleeding gums

—are nature's warning of approaching pyorrhea. Dental clinics since 1908 have proved the effectiveness of Pyorrhocide Powder as an aid to correct bleeding gums, strengthen tender gums, harden soft gums.

It keeps the teeth white and clean. Its tonic and stimulating qualities help healthy gums to *keep* healthy. It is medicated with Dentinol, a gum-tissue healing agent widely used by dentists in the treatment of pyorrhea.

Use Pyorrhocide Powder daily—see your dentist regularly—and you can avoid pyorrhea. The economical dollar package contains six months' supply. At all druggists. Send for free sample and booklet on causes and prevention of pyorrhea.

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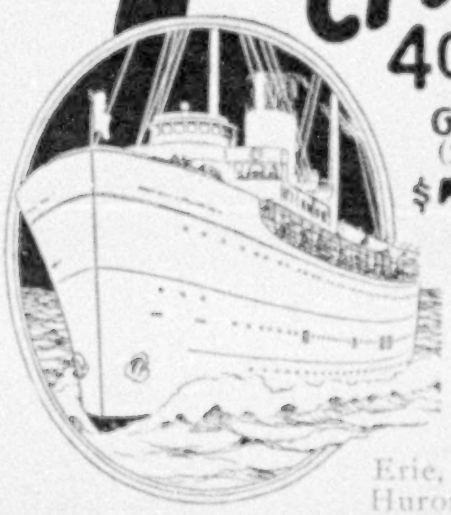

A sight-seeing Cruise De Luxe of over 2,000 miles on Lakes Erie, St. Claire, Huron, Michigan and among the 30,000 Islands of Georgian Bay. Visiting historic Mackinac Island, Parry Sound (Canada), Detroit, Cleveland and Buffalo (Niagara Falls).

See the alluring attractions of Chicago—metropolis of the West. (Stop-overs can be arranged in advance.)

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North American *and* South American

in comfort and luxury are comparable only with the finest Atlantic Steamers. Promenade and Sun Decks of unusual width; large Grand Salon; commodious Lounge Rooms; Palm Garden on observation deck. All Staterooms and Parlor Rooms have perfect ventilation (no inside rooms). Excellent meals daintily served by waitresses neatly dressed in white. Open air play-ground, screened in, with attendant, for children. Rest in quiet seclusion or join in the gaiety on shipboard, as you prefer. The canopied palm garden is ideal for relaxation. Vigorladen breezes will put new life into you. The Social Hostess will get you acquainted that you may enjoy to the utmost Dancing, Music, Entertainments, Deck Games, etc.

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Chicago, Buffalo, Detroit, Cleveland and Return

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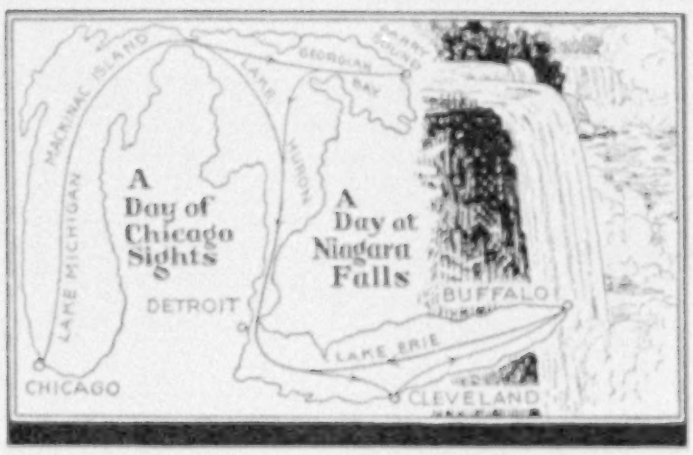

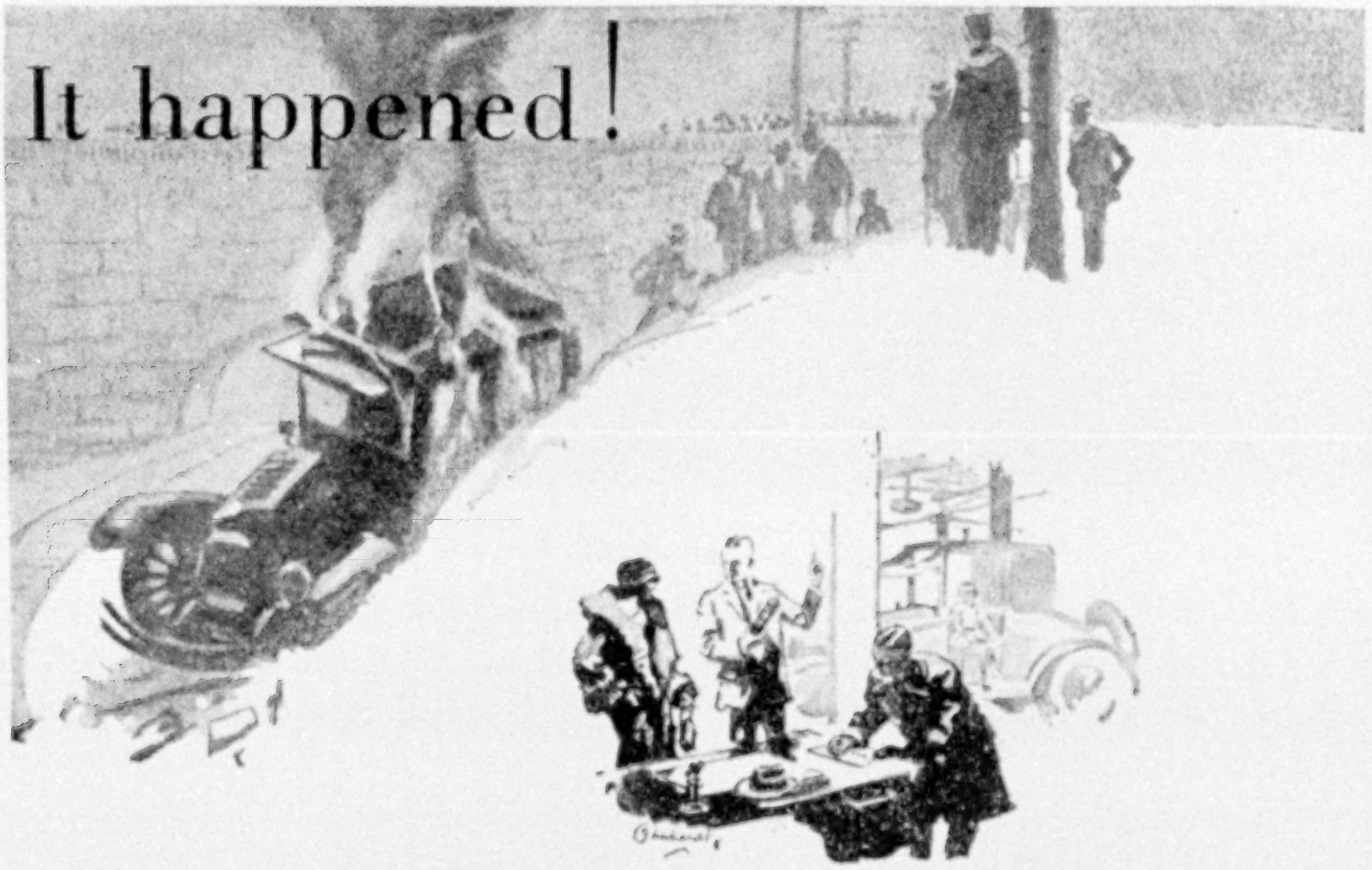

Before you, your wife and the children take the first ride in the new closed car, be protected against fire.

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If a fire should start, serious injury to some members of your family may result unless you have a Pyrene at hand.

With a Pyrene you can put out instantly any fire before it spreads and so save life and property.

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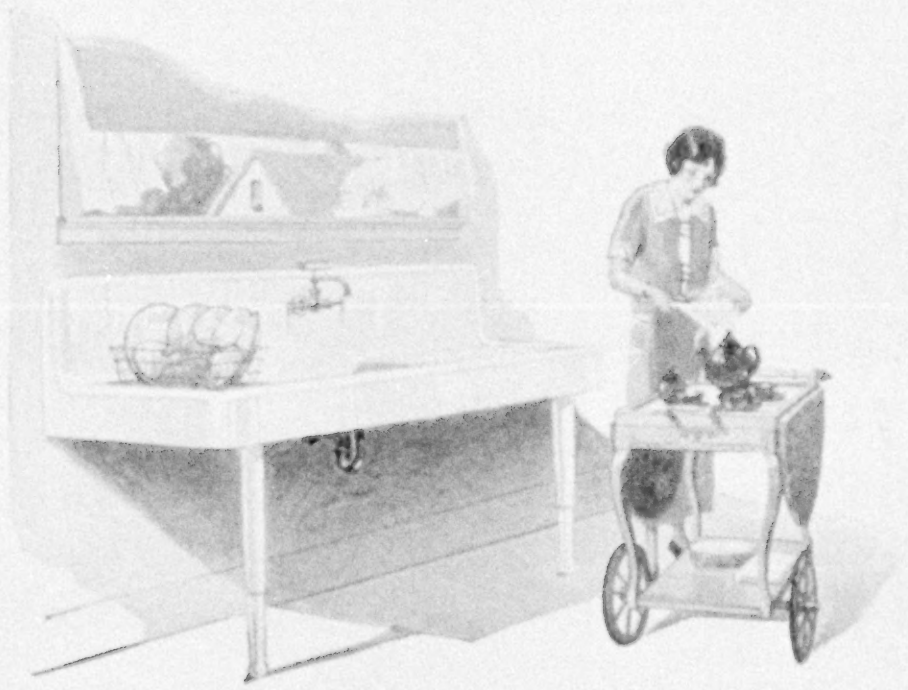

Every kitchen deserves a good sink

What woman would not choose this beautiful Kohler sink?—for its roomy double drainboards; its back to protect the wall from spotting; its unbroken expanse of sanitary white enamel, as easy to clean as a saucer; its height, adjustable to *her* height?

Here, really, is a wonderful sink; a wonderful work-saver and strain-saver. A little large, perhaps, for a kitchenette? No matter, there are other Kohler sinks, and one of them was built to fit your kitchen.

Kohler kitchen sinks are just as fine in every way as the Kohler fixtures that you find in the best-appointed bathrooms. There is only one Kohler quality, and that is marked for your protection by the name "Kohler," unobtrusively fused into the snow-white, durable enamel—pride-mark of a firm half a century old.

Kohler Ware is not more expensive than any other ware that you would care to consider. It is sold everywhere by the best class of plumbing dealer. The Kohler booklet, which we will gladly send, will tell you more about this good ware.

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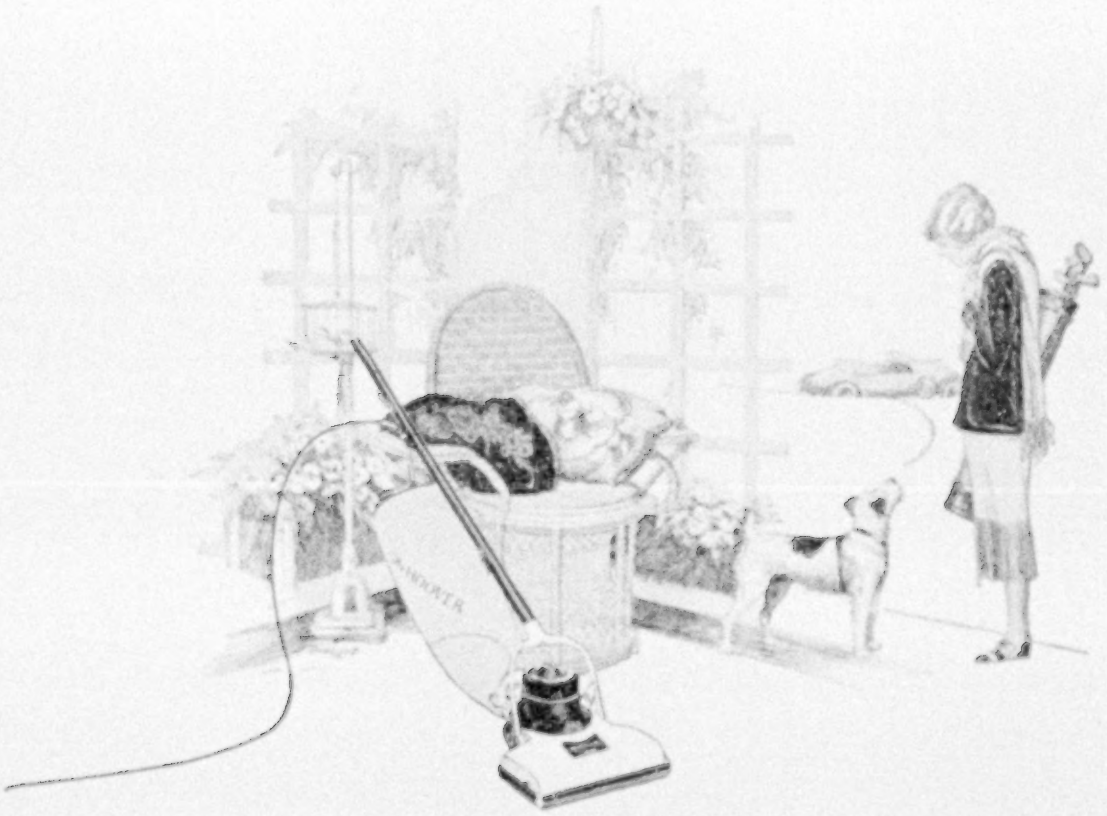

Ten Thousand Extra Hours for You!

Tucked away in the sockets of your electric light fixtures are ten thousand toil-free hours!

These are the hours you've often wished for, but never had.

And now, with summer here, you badly need them!

How can you get these extra hours? Simply turn the switch of a Hoover and let the endless power in that electric socket pour forth to do your bidding.

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And one by one, you will put to some good use these hours The Hoover saves you, day by day.

The Hoover never tires, nor do you as you glide it. The Hoover neither slights nor shirks.

It keeps quietly to its work until the very last speck of sharp-edged, gritty, embedded dirt is beaten out and suctioned away—

Until the very last thread and hair and piece of lint is swept up and whisked safely into the Hoover bag.

And with its newly devised attachments you can easily and *dustlessly* do all of your dusting.

When will you start to save *your* ten thousand extra hours, with The Hoover?

See your Authorized Hoover Dealer *today*. His plan of easy payments makes it no burden at all to buy the new model, with its ten added features.

THE HOOVER COMPANY, NORTH CANTON, OHIO
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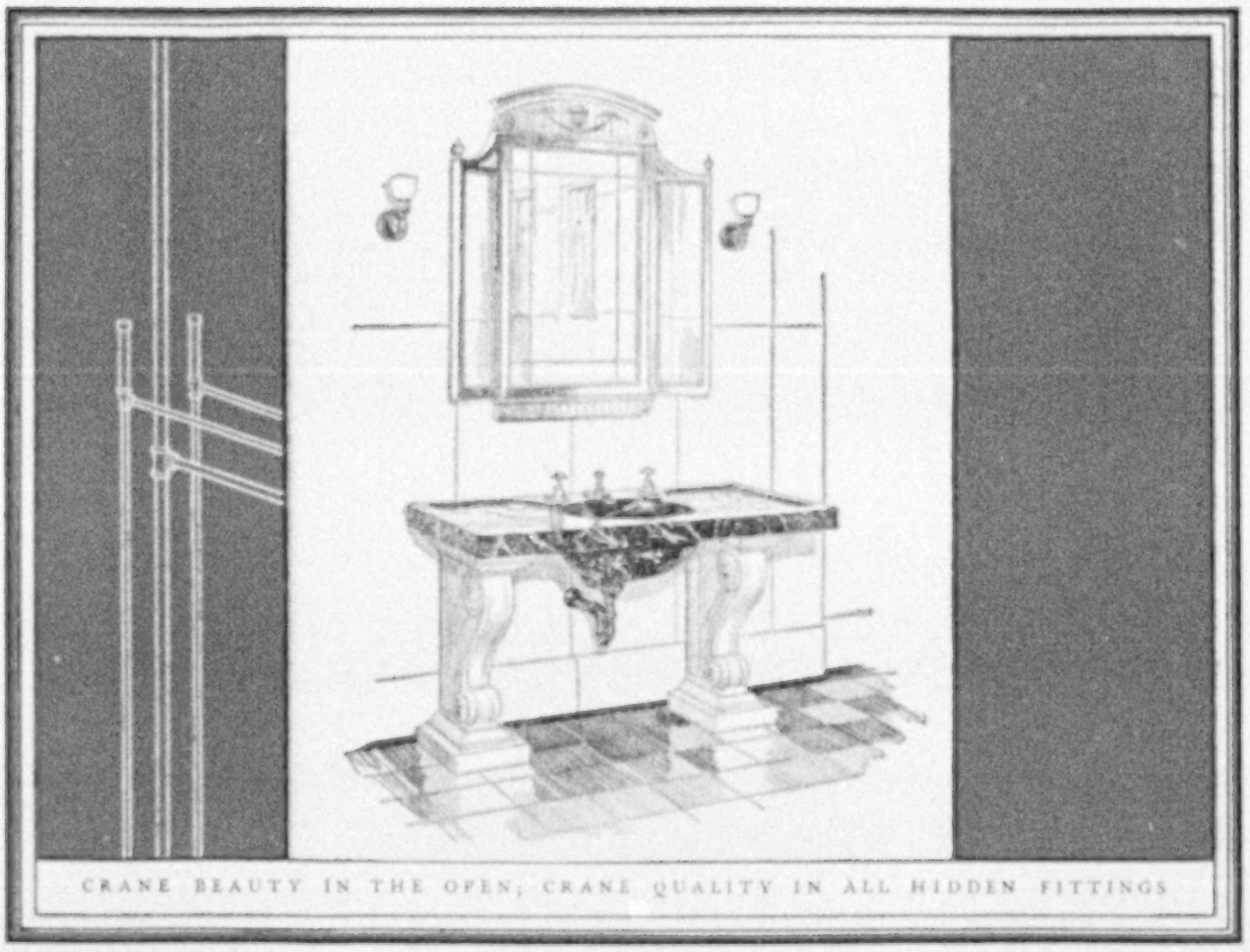

CRANE BEAUTY IN THE OPEN; CRANE QUALITY IN ALL HIDDEN FITTINGS

Distinctive appointments for the bathroom or lavatory are now recognized as essential equipment in homes where taste and refinement have complete freedom of expression. The console lavatory pictured above has a broad top of Levanto marble, soft black with rose and white veins. The supports are white Cararra statuary marble, the fittings heavy gold plate. The swinging panels of the triple mirror conceal cabinets for toilet things. In the wide range of Crane plumbing and heating materials—sold only through contractors—there are fixtures and accessories within the reach of all. Let us send you "The New Art of Fine Bathrooms."

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